THURSDAY, OCTOBER 15, 1885

COMPARATIVE ANATOMY AND PHYSIOLOGY

Comparative Anatomy and Physiology. By F. Jeffrey Bell, M.A., Professor of Comparative Anatomy at King's College, London. (London: Cassell and Co., Limited, 1885.)

THIS work is one of a series of "Manuals for Students of Medicine," each of which is to be "compact and authoritative"—"embodying the most recent discoveries," and also to "contain all the information required for the medical examinations of the various colleges, halls, and universities in the United Kingdom and the Colonies."

On behalf of those of our readers who may be unfamiliar with the demands of certain of the examining bodies referred to above, it may be well to state that nothing but a *résumé* of all that is known in the subject could meet the requirements of the case. That which the publishers demand, and which the public therefore has a right to expect under the conditions laid down, is an ultra-condensed digest of all authoritative work in zoology and physiology. Incredible though this may appear to any one acquainted with the bibliography of the subject, Prof. Bell's manual is so far satisfactory that we cannot but congratulate the publishers upon their choice of an author, whose work in connection with the *Journal of the Royal Microscopical Society* and the *Zoological Record* render him *par excellence* the man for this *opus mirabilis.* When it is stated that there are but 548 pp. to the book it will be clear that it must be a vast collection of facts, little being left as to style or originality for that criticism which the author invites. The method of treatment, however, is somewhat novel, and in our opinion open to comment.

The author divides his work into fourteen chapters. Of these the first is introductory; the second is devoted to the Amœba as a physiological study; the third to "the general structure of animals," that is, to a consideration of the "broader characteristics of the groups into which the animal kingdom has been divided." Those which remain are devoted, each to one of the great systems of organs and to development.

In estimating the value of this volume, it must be clearly borne in mind that it is a book intended for beginners. Chapter II. is written for biological babes, and it will be clear to any one who reads the volume that the author would have the student familiarise himself with the facts in the order in which they are presented to him. This being so, it is a pity that Chap. I. should have been so largely devoted to the subtle details of cell-structure; the beginner is lost in descriptions of the "cytod" and the "cell," for each of which broad differences are dogmatically formulated, such as would tend to bias the mind of the average student. Draw hard lines by all means for the beginner, but not in such delicate matters as these. Only by working from the known to the unknown, can the student of science ever hope for success; the order of his elementary studies must be a recapitulation of that in which the science itself has advanced—he must here begin with gross anatomy, and we believe that to treat first of the subtle details of cell structure is to do violence to the cause of inductive science. A somewhat similar comment may be offered upon the manner in which the great phyla are dealt with in Chap. III. Having devoted nearly half the chapter to defining these, the author proceeds (pp. 58, 59) to deal with types of each. He prefers to commence with the Echinodermata, dealing thus "first of all" with the "most aberrant" phylum. If the Echinoderms are dismissed as a stumbling block, why not the Brachiopods, the Polyzoa, and certain other creatures well known to zoologists? These are all wisely relegated to the end of the chapter, as "groups of animals which in the present state of our knowledge cannot be satisfactorily placed with any of the great phyla" (p. 100). Just so, but why not put the Echinoderms there also If the student is to be allowed the exercise of any judgment in the matter, he cannot be expected to deal with the aberrant before he is familiar with the normal, and more stereotyped grades of organisation.

Although the work is professedly a text-book of comparative anatomy and physiology, the latter branch has suffered much in the process of condensing, necessary we presume in order to keep the book within the prescribed limits. At the commencement of each chapter a concise definition of that system of organs to be dealt with comparatively is given, together with a brief description of their functional activity; but the field of comparative histology is sorely neglected. The author neither furnishes the required information on this subject, nor does he take for granted that his readers have worked through even the broad principles of it. The student is occasionally referred (*Ex.* pp. 368 and 372) to Klein's "Manual of Histology"—a fellow volume to the one now before us; but as that work deals with the subject altogether from a special human-anatomist's point of view, the reader is at a loss to make much of the subtle differences in the comparative anatomy of, say, shells and teeth, until he knows more precisely than he is here informed what is involved in an exoskeleton and a tooth. Similarly, the statements made (p. 258) concerning the vertebrate excretory system are altogether too brief and dogmatic. The student is merely informed that *Meso* and *Metanephros* exist; of their adult structure he learns little or nothing, and in the face of such descriptions of the essential structure of an excretory organ as are given, he would be at a loss to make much of that of the vertebrate at any rate for himself.

Chapters V. and VI. are also at a disadvantage from this curtailing of the histological portion of the subject. The definition of the blood given (p. 181) would not convey to the beginner's mind a notion of its real complex nature; he would rather infer that it is merely "the result of the process of digestion," in function "respiratory as well as nutrient." Least successful of all the definitions given of great systems is that (pp. 393-94) of the nervous system, and it is exceedingly unfortunate that (p. 411) the nerves should be described as bringing or carrying "messages." A fascinating conception of the nervous activity this may be, but it is a commonplace one, well known to every teacher of physiology; the mischief attendant upon its use is patent, and it is highly desirable that special efforts should be made to secure its abolition. Its adoption in this work is therefore greatly to be regretted.

Prof. Bell's book is fully up to the date of writing, and the subject-matter is for the most part judiciously selected and arranged; but in a volume where so much of fundamental importance to the student is recorded, we could wish to see more discretion used in the transcription of certain hypotheses. We frequently find the most elementary facts set down side by side with the most daring generalisations. Nowhere is this more conspicuous than on p. 85, where Hubrecht's well-known Nemertean-Vertebrate hypothesis is referred to. The author mentions this with a caution it is true, but its introduction in the manner adopted, and with the illustrations given, is out of place. Again, a teacher is not justified in telling a novice as a *procès verbal* in an elementary text-book that "the Echinodermata, the Arthropoda, and the Mollusca form (p. 84) three very distinct branches or phyla, the common ancestor of which is to be sought for only in a simple worm." Neither is he justified in asserting (p. 403) without further qualification than is here given, that "with the exception, then, that in Peripatus and Proneomenia, the anterior end of the nerve-cords is enlarged into a cerebral mass, we should appear to be able to see no essential difference between them and a Craspedote Medusa, save in fact that the Medusa has a complete nerve ring." Statements such as the above may prove in the long run to be expressive of the truth, but if introduced into a text-book, efforts should be made to convey to the mind of the student some notion of what they involve. The beginner is too ready to rely upon his teacher and his text-book at all times, and the admixture of elementary facts with startling hypotheses is—in a work of this order—directly opposed to the true scientific principle. The natural tendency to generalise prematurely needs to be checked rather than otherwise, and if countenanced by a teacher, it must lead to fallacies greater and more mischievous, than were those of the catastrophic school.

There is a dangerous sketchiness about certain portions of this work. For example, on pp. 185 to 193 there is instituted a brief comparison of the great blood-vessels in the leading groups of animals. The descriptions given would lead one to infer that the antennary, hepatic, and sternal arteries of the Crustacean, and the auricles of Mollusca, are serial homologues of the circular commissures of a worm (here called "transverse"); this is in fact stated (pp. 186, 189) to be the case. The argument used above applies equally well here, and we are at a loss to imagine the state of him who, with the aid of this book, shall try to ascertain the actual condition of these vessels in the admittedly all-important worm.

When we reflect upon the advisability of placing this work in the hands of the average medical student, it must be admitted that it is not calculated to be of much service to him during his ordinary student life, except as a cram-book for the examination-room. The author has, by the terms of his agreement, pledged himself to produce a *précis* of all that is of first importance on the subject. The work will be very valuable as a remembrancer and book of reference to those who already know something definite of the broad principles of the science, and we conceive of it as calculated to be of especial service to geologists and others, whose work among the "dry bones" occasionally needs the light from within. So far as the medical student is concerned, it must be admitted that he is overtaught, and it is monstrous to reflect that there exist systems of medical education, such as have necessitated the production of this book as a "Manual for Students of Medicine." The days for "signing up" attendances on long courses of lectures upon zoology and botany are—or ought to be—numbered; and if, as is most desirable, the biological leaven is to be introduced into the medical curriculum, it can only be done to good purpose along lines such as have been successfully laid down, mainly by Prof. Huxley.

There is undoubtedly a need of a sound elementary book, which shall be up to date, on "the general structure of animals," and Chap. III. of this volume supplies the want in a measure. The paucity of certain parts of this, however, is a serious obstacle to its adoption, for diagnoses such as are given for the Scaphopoda (p. 82), for the Copepoda (p. 68), and for the Siphonophora, are of little avail.

Taking the book as a whole, the success with which the author has performed his task will be obvious to any one cognisant of the immensity of the field. Small errors cannot well be excluded from a work of this kind, but the volume contains some which ought to be rectified as soon as possible. For instance, there is no good ground for stating (p. 359) that the sesamoids are "no doubt to be explained by a reference to the primitively multiradiate condition of the vertebrate limb," and there is something akin to a contradiction in the assertion (p. 140) that the teeth are "developed from cells of epiblastic origin," and that there is "a community of origin between what have been well called dermal denticles and what we call teeth." One remarkable instance of the manner in which errors of observation may be spread and distorted in the process of abstracting, is to be found on pp. 301 and 377, where we read that the telson "sometimes, though very rarely (Scyllarus), *bears minute appendages*." We mention this as the author lays stress upon it, and unless we are mistaken in the identity of the paper from which the above idea has been culled,[1] an attempt was merely made to show —and that unconclusively—that "the telson is a true body segment with lateral appendages, which are modified by cohesion and adhesion." He who abstracts cannot be expected to verify the accuracy of every statement he reproduces—life is too short for that—but a matter such as the above should not have been allowed to pass. In defining the Arachnida (p. 72) it is stated that "the mouth is never placed so far back that any of the appendages become antennary organs." This is but one view of a complicated and deeply involved question, and, even should it chance to be true in the end, it is but a deduction at the most, and its use here as a definition is unwarrantable. This same deduction underlies the statements made on p. 303 under a similar head, and also the insertion of the footnote uncalled for to p. 224. The first mention of the "transverse processes" of the vertebra (p. 314) as "given off" from the centrum is to be regretted, as it leads up to a complete misunderstanding of the nature of the component parts of the adult vertebra; and, passing (pp. 324-25) from a somewhat jerky description of the vertebral column, it is doubtful how far it is wise to usher in so complex a subject as that of the skull, by a direct appeal to embryology. The statement (p. 325) that the trabeculæ "never form more than an

[1] Garrod, *Journal of Anatomy and Physiology*, May 1871.

imperfect roof" in the region of the fore-brain, hardly accords either with fact or with the characters delineated in Fig. 138. In dealing with another complex matter—the origin of the fœtal membranes—the student's attention is abruptly transferred (p. 509) from the vitelline membrane to the amnion, and that in such a manner that he would scarcely follow what is really meant. Closely allied is the description of the germinal layers, and we doubt if the bare statement (p. 34) that "the outer and inner layers undertake the functions which their position entails on them" is justifiable.

The work is got up in good style. The technical terms are printed in large type, but the choice of these is not always happy; on p. 5, for instance, in describing the movements of living protoplasm, we find the words "stream" and "gliding" set up in large letters; while, on p. 12, where the time-honoured terms "ontogeny" and "phylogeny" cannot well be dispensed with, neither they nor equivalents are employed—in fact, but for the aphorisms quoted on p. 13, the arguments used under the head of "development" would hardly carry conviction. Considering the nature of the book there are very few typographical errors. The more important are: p. 49, the description of Aspidogaster as "*ecto*parasitic;" p. 138, the "*anterior posterior* of the digestive tract;" and, p. 501, "the *cephalous* Mollusca, such as the mussel," &c. The illustrations are, for the most part, fairly good. Fig. 11, representing, as it does, only one-half of an anemone, is not easily intelligible to the reader, and the student should be informed what the right half of Fig. 22 is intended to illustrate. Fig. 66 illustrates but feebly part of an important subject—Mammalian odontology—which is poorly dealt with. Figs. 36, 42, 81, 82, 101, 170, and 192, are all out of place in a work of this kind. They convey little or no impression to the mind of the student, and are bare schemes such as an observer might construct for use in his own private notebook *side by side with actual drawings of the facts observed.* Diagrams such as Fig. 101 should never be shaded up, as if indicative of actual appearances.

To sum up. The author has successfully produced, at immense labour, a volume, of service to those who already possess a practical knowledge of the broad principles of the subject. A "Manual for Students of Medicine" it emphatically is not, except under that atrocious and misdirected *régime* of parrot-work not yet extinct. For this the system, and not the author, is to blame; he has performed a good service, the return for which will but ill repay him. G. B. H.

BRITISH DAIRY FARMING

British Dairy Farming. By James Long. (London: Chapman and Hall, 1885.)

THIS very readable volume is from the pen of one who evidently understands the highly technical subject to which he has devoted himself. Writing upon agriculture has too often been attempted by mere theorists, and as an inevitable consequence practical men have been contented to cursorily scan and forthwith consign both book and author to oblivion. In this department more than in many others those who know are not book-writers and those who are book-writers do not know. Mr. Long is happily able to exercise the discernment which comes of knowledge in the marshalling of his facts and the quality of his suggestions. In his introductory chapter he gives solid statistical reasons why we should as a community endeavour to "produce more and import less," and the subsequent chapters are devoted to a review and comparison of our dairy system and those of our Continental neighbours, much to the advantage of the latter. The genius of the English farmer does not appear to have as yet shone into his dairy. His fields, his machines, his cattle stalls, his animals, have each and all been the admiration and the model of Europe and America. But he pauses on the threshold of his dairy and, we may add, his hen-house. These are, he thinks, the proper domain of the dairy-maid or the housewife, and the farmer is done with the milk when he has set it down at his dairy door.

It is a case parallel with that of our *cuisine*. We produce the finest beef and mutton, but we are only too constantly reminded of the forcible old proverb that while God sends meat the Devil sends cooks. There is some ground for hope that we shall, if only by force of competition, be compelled to further elaborate our products. English cheese is excellent, but it is lamentably wanting in variety, and certainly is much too apt to be regarded as one of the necessaries rather than as one of the amenities of our daily fare. Butter-making offers fewer facilities for innovation, but much requires to be done before we can successfully compete with the butter-makers of Denmark, Normandy, and Brittany. It is to cheese-making that Mr. Long devotes the largest share of his space. In England the principal cheeses may be almost told off upon the digits of one hand: they are "Stilton, Cheshire, Cheddar, Gloucester, Derby, and Leicester." The two last are, however, a little less definite than the first four, and we do not quite see their right to continue a list so well begun. Derby and Leicester are, no doubt, very good cheeses, but if they are to be admitted to stand in the same relation to English dairying as Stilton and Cheddar, we think Mr. Long might well have increased his list by adding Cutherston, Dorset-blue, North Wilts, and other cheeses well known to thousands of admirers. The principal English cheeses are, however, undoubtedly the first four mentioned in Mr. Long's list, and, with the exception of the Stilton, none of them can compare, in the estimation of an epicure, *connoisseur*, or *gourmand*, with the soft, rich, palatable cheeses imported to this country under a puzzling variety of appellations.

The chief interest of Mr. Long's book consists in his minute workable descriptions of the manufacture of a large number of cheeses, which indeed appear to be as numerous and various as are different sorts of wines. The book is well illustrated, and the "plant" required for carrying on the manufacture of some of the cheeses is complicated and expensive. Still, there appears to be no reason why similar cheeses should not be successfully made in England, and it is not improbable that the processes would be further improved in English hands were the matter once taken up.

Take, for example, Camembert:—

"The rennet is added to the milk at a temperature similar to that at which it is drawn from the cow: it is heated in a tub, and a portion of the morning's milk is added to the milk of the previous evening. . . . When the rennet is added the milk is gently stirred with a long spoon for two or three minutes; a wooden cover is then placed on each pan, and it is left for five or six hours. . . . The curd is then taken out by spoonfuls and put into cylindrical white metal moulds which cost about 4*s*. 6*d*. a dozen, and which are open at both ends. These are previously placed upon rush mats upon slightly inclined tables, and which have on the lower extremity a small gutter which carries off the whey into a receptacle beneath. . . . When the curd has remained two days in moulds the cheese possesses consistency enough to enable it to be moved with ease. Then the left hand is placed beneath it, and, assisted by the right hand, cheese and mould are turned, so that the top face is placed at the bottom, in contact with the mat. At the end of thirty-six to forty-eight hours from filling, the cheeses are taken out of the moulds and salted. . . . When salted, they are placed upon the wooden shelves above the draining tables, and here they are left for two or three days until they are ready to be sent to the *hâloir*."

We have quoted the foregoing passage in order to show that there is nothing more complicated in the making of a French Camembert cheese, nor yet so complicated, as in the making of an English Cheddar. Whether by following Mr. Long's directions an English dairyman could produce the correct type and flavour can only be demonstrated by trial, but probably a cheese would be produced suitable to English methods which would add to the variety of our dairy products and find a ready market. Mr. Long also describes the manufacture of various other cheeses, among which are Pont l'Evêque, Livarot, Mignot, Boudon, Brie, Gérômé, Coulommiers, Mont d'Or, Void, Suisse, St. Remy, Gervais, St. Marcellin, Jour iac, Gex, and a large number of others, the mere mention of which would occupy more space than we can spare.

Mr. Long has certainly contributed a handy text-book which it is hoped will find its way among and be studied by dairy farmers.

JOHN WRIGHTSON

OUR BOOK SHELF

Chain Cables and Chains. By Thomas W. Traill, C.E., R.N., the Engineer-Surveyor to the Board of Trade. (London: Crosby Lockwood, and Co., 1885.)

IN the volume before us we find the business of chain cable-making in its several branches well explained and illustrated; nor does the aim of the author end here. There is information given which is most useful to surveyors and inspectors, and we recommend all who have to deal either with the manufacture, inspection, or testing of chain cables to study the work. The volume contains many well-executed plates, showing good, bad, and indifferently-formed links, &c., for various kinds of cables, also tables of the best dimensions of each part of each link and shackle used in cables from 7-16th to 2½ inches, the dimensions being given in decimals to two places, and also calculated to thirty-second parts of an inch. We find also exact copies of certificates given by the several public proving establishments, seven plates in all, more than one example being quite unnecessary, varying as they do only in colour and the name of the town in which the establishment happens to be.

After a few pages giving an outline of the general manufacture and the methods of welding the links, we have a long historical chapter of the early uses of metallic chains, in which we are told that their uses date back to the time of Pharaoh and King Solomon; but it was not until 1808 that chain cables were used on board ship; at this time a chain cable was used in a vessel called the *Ann and Isabella*, of 221 tons, built at Berwick, and owned by Joshua Donkin. This cable was made by Robert Flinn, in North Shields, perhaps the first artificer in chain cables. In the year 1833 the first machine for testing iron cables in a Government yard was put down at Woolwich, and in 1834, although chain cables were almost in general use, the rules of Lloyd's Registry only specified the length, and it was not until twelve years afterwards it was part of the surveyor's duty to see that they had been properly tested. The author gives a very interesting account of the progress of manufacture and general adoption of iron cables. We then find the various Acts of Parliament pertaining to their use given in full. All public proving establishments are now under the management of Lloyd's Committee.

The method of proving chain cables is as follows:—From every length of 15 fathoms of the cable to be proved a piece consisting of three links is taken and subjected to an appropriate breaking-strain. If the piece so selected fail to withstand such a breaking-strain, another piece of three links is taken from the same 15-fathom length and tested in a like manner. If the first or second of such pieces withstand the breaking-strain, the remaining portion of the 15 fathoms of cable is then subjected to the tensile strain. If it is found that after the application of the tensile strain the cable is without defects or flaws, it is then stamped as proved with the distinguishing marks of the proving establishment; on the other hand, should the cable fail to stand the appropriate tests, it is rejected. Mr. Traill condemns the overtesting of cables, considering that the material is injured by so doing, and we agree with him in saying:—"A moderate test is all that is not detrimental. Proving the iron from which the cable is made, and breaking a sufficient number of samples, is what can and should be done to prove the actual quality and reliability of a chain."

The volume does great credit to the publishers, being well printed on good paper. We can safely recommend this work to all in any way connected with the manufacture of chain cables and chains as a very good book.

United States Coast and Geodetic Survey. Determination of Gravity at Stations in Pennsylvania, 1879-1880. *Appendix No.* 19. *Report for* 1883.

THIS appendix is a portion of the Annual Report of the U.S. Survey, and contains the pendulum observations made in 1879-1880 by Mr. C. S. Peirce at three stations in Pennsylvania—namely, at the Alleghany Observatory, at Ebensburg, and at York. The observations form part of a series undertaken in connection with the Geodetic Survey of the United States. A Repsold reversible pendulum was used and oscillated *in vacuo*, using various kinds of supports. At York a series of experiments were made to determine the effect of the flexure of the support. It appears from a previous report (Appendix No. 14 of 1881) that Mr. C. S. Peirce maintained against MM. Plantamour and Hirsch in Switzerland, that the oscillations of the support have a marked effect on the time of oscillation of the pendulum, and he accordingly undertook an exhaustive series of experiments to prove his point, and to measure the allowance to be made. The experiments given in Appendix No. 19 are only a small portion, and are in fact re-published from Appendix No. 14, with some few corrections. The question was disposed of in Appendix No. 14, and it was clearly shown that the flexure of the support ought to be taken into account, and it is evident, therefore, that the stiffness of the support is of vital importance. Experiments were also made at York to determine the relative value of the method of transits and a method of eye and ear coincidences invented by Mr. Farquhar; the method is not described, but appears to be far less accurate than the method of transits. The effect of substituting steel cylinders for the usual knives was also tried, and every care taken to prevent the inclusion of dust, but the results were very unsatisfactory.

The results obtained are as follows:—

Length of second's pendulum reduced to sea-level at the equator.

	Metre.
Alleghany Observatory	0·9909384
Ebensburg	0·9910672
York	0·991015

At Alleghany, the effect of a valley was not taken into account, as there was no topographical survey available; the necessary correction will slightly increase the above value.

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.*]

The Presence of the Remains of Dicynodon in the Triassic Sandstone of Elgin

IN my address to the Geological Section of the British Association I was fortunately able to announce a discovery which is of the very greatest interest both to geologists and biologists. As this discovery was made only a few days before the commencement of the meeting at Aberdeen, and after the draft of the address was in type, it does not appear in your columns; I will therefore ask you to insert this note upon the subject. Visiting the "Cutties Hillock" quarry near Elgin early in September, I found that the workmen had recently obtained a new specimen of a reptile, in which the head was preserved. On examining this I found that there were clear indications of two large canine teeth in the upper jaw with permanent pulp cavities. These characters and the general form of the skull left scarcely the smallest doubt in my mind that the remains must belong to a reptile closely allied to *Dicynodon*. From the examination of a photograph which I submitted to him, my friend Dr. Traquair was able to fully confirm this conclusion, and to lay a preliminary note on the specimen before the Geological Section at Aberdeen. I hope that ere long he will be able to give a complete description of it.

As Dicynodonts have hitherto been only found in South Africa, in India, and in the Ural Mountains, this discovery is an exceedingly important one. Seeing that doubts have been expressed concerning the Triassic age of the South African deposits, the occurrence of the very characteristic African form in the Trias of Western Europe is an important link in the chain of evidence by which these beds have been correlated. It is interesting, too, to be able to point out that the sandstones of Elgin, concerning the age of which such a great amount of controversy has taken place, have now yielded reptiles belonging to no less than *four* orders—namely, the Lacertilia, the Crocodilia, the Dinosauria, and the Dicynodontia. J. W. JUDD

An Earthquake Invention

WHILE on a visit to the Melbourne Observatory I saw NATURE of July 2 containing two letters from Prof. Piazzi Smyth, intended to expose a piratical attempt on the part of a "B.A. man" to adopt an idea of Mr. David Stevenson with regard to the construction of houses to withstand earthquake motion. The publication of the first of these letters is at the request of Mr. D. A. Stevenson. The piracy referred to by Prof. Smyth is a brief note in a paper written by myself. My name is at the head of it (see *Report* to the B.A. 1814). Prof. Smyth complains that I have not taken notice of a paper written some twenty years ago by Mr. D. Stevenson. I regret to say that I am not acquainted with that paper, and how Prof. Smyth expects that I should be when living 10,000 miles away from collections of European books, I fail to see. I am, however, acquainted with very much relating to aseismic or aseismatic tables, and if I made reference to the work of Mr. David Stevenson, I must necessarily have referred to the work of others. As every report which I have hitherto written for the British Association has been in the form of notes which have subsequently been expanded in special papers, an historical account of aseismic tables would have been out of place. Prof. Smyth is apparently only acquainted with the work of Mr. D. Stevenson. Under the head of aseismic tables I include ball and plate seismographs, the lamp tables in certain Japanese lighthouses, two model houses which I constructed in Japan, together with the model lighthouse spoken of by Prof. Smyth, and my own dwelling house. *All of these involve the same principles, and they only differ in their dimensions.*

(1) *Ball and Plate Seismographs.*—Of these seismographs I have constructed *several* types. At the time of an earthquake, in consequence of acquiring a surging movement, they fail to give reliable records. They have been *independently* invented and described as original by many. Mr. Briggs, of Launceston, Tasmania; Dr. Verbeck, of Tokio, Japan; Mr. T. Gray, of Glasgow; Mr. D. A. Stevenson, of Edinburgh, &c., have all been authors of such instruments.

Mr. D. A. Stevenson recently figured and described his form of seismograph in the pages of NATURE. If we overlook certain mechanical defects in this instrument, as, for instance, attaching a recording index to the edge of the "steady plate" rather than at its centre of inertia, the resemblance of Mr. Stevenson's contrivance is strikingly like a seismograph the photographs and descriptions of which existed in several societies and libraries in Britain prior to the appearance of Mr. Stevenson's invention. After reading Mr. Stevenson's description I did not ask for the publication of an "interesting" and "well-put" letter, accusing Mr. Stevenson of having appropriated the ideas of others, but I furnished him with copies and references to papers in the *Transactions* of the Seismological Society and other periodicals where mention was made of this type of instrument.

(2) *Lamp Tables.*—As I have been an officer in the Public Works Department of Japan for the last ten years, where I have every facility of knowing what the performance of the lamp tables at the lighthouses has been at the time of severe earthquakes, I trust that some credence may be given to what I may say on this subject. When I last made inquiries about these tables, I found that they were all regarded as failures and one and all had been clamped. If Mr. Stevenson would like to have details respecting these failures I shall, on my return to Japan, have great pleasure in making them public.

Mr. Mallet, in his "Palmieri's Vesuvius," very distinctly states that he was consulted by Mr. Stevenson respecting the Japanese structures, and that the principles indicated by him (Mallet) were followed out in their construction.

As Mr. Mallet is dead, perhaps Mr. Stevenson or Prof. Smyth will kindly enlighten us as to the meaning of this passage. Although I have made seismology a speciality for some years, I must confess that I am as yet in the dark as to who was the first inventor of the aseismic joint. To me it appears that there have been many inventors.

(3) *Models.*—My first model was about as large as a good-sized dog kennel. For a *short*-period oscillatory movement the house resting on its rollers remained at rest. Prof. Smyth speaks of Mr. Stevenson having imitated earthquake motion by the blows of a sledge-hammer. Although Prof. Smyth regards the blows of a sledge-hammer as an admirable illustration of earthquake motion, any one acquainted with the true nature of earthquake motion would decline to recognise Mr. Stevenson's test as any test whatever.

(4) *Building.*—The only *building* placed on free foundations with which I am acquainted is the one I have erected in Tokio. At first it rested on balls, and, like Mr. Stevenson's lamp tables, it was for certain reasons a failure. Now it rests on spherical grains of cast-iron sand. It is now astatic, and I regard it as a success. At the time of an earthquake the motion outside the house is usually about six times what it is inside. A description of it will be found in the *Reports* of the British Association for 1885.

From what I have now said it will be clear that I have no desire to claim the authorship of the aseismatic joint. Detailed reference to the obscure and manifold authorship of what has hitherto proved a failure would certainly have been out of place in the report to which Prof. Smyth has referred.

Had Messrs. Stevenson and Smyth been acquainted with the nature of earthquake motion, a few of the more important facts in the history of the ball and plate joint, and the details of the failure of the tables in the Japanese light-houses, I feel sure that much of the objectionable innuendo to which I have been subjected would never have been penned. JOHN MILNE

s.s. *Waihora*, Hobart, Tasmania

P.S.—The above has been written whilst at sea, and I have neither had opportunity to refer to books or papers. On my return to Japan I shall be glad to continue the history of the ball and plate joints, should it be required.

Tremble-terre du 26 Septembre, 1885

UNE seule secousse a été constatée le 26 Septembre à oh. 58m. du matin ; elle a été composée de 2 à 3 oscillations, de direction variable suivant les localités. Le centre de la secousse a été dans le milieu du Valais, où son intensité a été appréciée comme très-forte, mais où il n'y a cependant pas eu de dégâts matériels ; il faut lui attribuer le No. VI. de l'échelle qui évalue en dix degrés l'intensité des tremblements de terre.

La secousse s'est étendue vers le nord jusqu'à Schwenden et Zweisimmen dans le Simmenthal, à Château d'Oex, Aigle et Yvorne ; dans les Alpes vaudoises elle a été foit bien sentie dans les vallées de l'Avençon, de la Gryonne, de la Grande-eau, et de la Savine. Dans tout le reste du canton de Vaud le tremble-terre semble avoir passé inaperçu, tandis qu'il nous est signalé de deux localités fort distantes, Genève et Nidau ; il est cependant probable que la secousse de Nidau a précédé de quelques minutes la grande secousse du Valais ; d'après un observateur très précis la secousse de Nidau a eu lieu à oh. 53m.

En même temps que le sol de la Suisse était ainsi ébranlé, les appareils très délicats de l'observatoire sismique de Rome, qu' avaient été en repos les jours précédents, ont signalé des vibra tions du sol vers 1 heure du matin ; et dans le même nuit un violent tremblement de terre ravageait la ville de Nicolosi près de Catane en Sicile. F.-A. FOREL

Morges, 8 Octobre

Larvæ of Cerura vinula

LAST year I was rearing up some larvæ of *Cerura vinula*, the Puss Moth, from the egg, and I determined, while I had the chance, to write a life-history of them.

On examining the egg closely I found a small hole in the apex of each, and I thought at the time that this was probably caused by ichneumons, and therefore I laid the eggs by in a small box that I might capture the ichneumons when they made their appearance. Great was my surprise, then, when I found that the young larvæ came out as usual.

I therefore determined to get some more eggs and to find out whether this hole in the apex was caused by the mandibles of the larva inside, but I found that the larva did not emerge by this hole, but by a fresh one made in the side of the egg. And I find that all Puss Moth eggs have this hole in the apex.

I am now hoping to get some eggs of moths belonging to the same family (*e.g. Cerura furcula* and *bifida*) to see if they also are perforated in this way. I should be much obliged if any one who has got any of these eggs would kindly let me know whether this is the case.

This hole reaches through the shell of the egg, but is covered, on the inside (of the egg) with a thin tissue, like that which is found in birds' eggs.

I have carefully examined several scientific books, but have been unable to find this fact mentioned ; therefore I should be much obliged if any one could throw a light on this mysterious fact.

I unfortunately have none of these eggs to forward as examples ; but, as they are pretty common in May and June on poplar trees, I have no doubt that such of your readers as are interested in the subject will be able to examine them for themselves. CYRIL B. HOLMAN HUNT

Draycott Lodge, Fulham, October 9

Pulsation in the Veins

I AM quite satisfied that the pulsatory movement in the veins, to which my former communication referred, is not in any way *abnormal*, as suggested by Mr. Williams (p. 466). In *all* cases, without exception—and they have been a good many—in which I have had opportunity for the observation, the minute *visible* evidence of the pulsatory action has been present, and I have invariably been able to count the pulse of the individuals, as in the experiment detailed in my former letter.

The mirror experiment was tried on my own hand. And a medical friend who applied the sphygmograph in the usual way informed me that my pulse was free from any abnormality.

It is to be borne in mind that the pulsatory indications with which my paper is concerned are exceedingly minute and would escape the perception of nine persons out of ten—requiring an eye educated to appreciate very minute differences of shade and colour. I do not think that the bristles or sealing-wax thread which a correspondent (p. 437) kindly suggests, or even the orthodox sphygmograph would have a chance of effectually exhibiting them. I say shade *and colour* : for when a vein free from turgidity, and not sensibly altering the smooth surface of the skin, is seen only by its blue track, a modification of the *tint* is perceptible (to an educated eye) ; and the blue varies in intensity with the pulsatory action, sufficiently for the success of the pulse-counting experiment. J. HIPPISLEY

Stoneaston Park, October 4

Stonehenge

IN NATURE, vol. xxxii. p. 436, R. Edmonds associates Stonehenge with the metonic cycle, and quotes from Diodorus Siculus, whom he says flourished about 44 B.C. Would not the latter part of the first century A.D. be more accurate? He gives in his extract from Diodorus Siculus a quotation from Hecatæus, whom he confuses with Hecatæus of Miletus, when it was Hecatæus of Abdera to whom Diodorus referred. Hecatæus of Miletus flourished about 500 B.C., and Hecatæus of Abdera about 300. Mr. Charles Elton, M.P., in his "Origins of English History," gives the very same extract, and says that "We cannot admit that the work of Hecatæus is on the subject of Ancient Britain," and estimates its value in the following extract from the works of an eminent Polish scholar (Lélewel, Pythéas, 45): "Hécatée a publié un fameux ouvrage dont le titre décèle une vieille idée poétique rajeunie sous sa plume. Elle devait s'allier aux nouvelles découvertes et y prendre une place éminente au détriment de la science et du bon sens. Hécatée, énumerant tous les êtres mystérieux de la géographie septentrionale, enrichit leur nomenclature d'une rivière Scythique récemment trouvée en Orient par le conquérant, qu'il a appelée Parapamisos ; et plus encore des promontoires et des îles Celtiques, qu'il a probablement puisées dans les rélations véridiques de Pythéas pour les entrelacer dans les plages superboréennes."

The quotation from Diodorus is from his second book, but the whole of this second book is dedicated solely to a description of Asia ; and it is not until the fifth book is reached that he describes the British Isles, and with a very considerable degree of accuracy. (See Fergusson's "Rude Stone Monuments," p. 8).

I do not think, either, that "Nine Maidens" is simply an abbreviation of "Nineteen Maidens," for, like "Nine Ladies" of Stanton Moor, in Derbyshire, it is a memorial circle.

Stone Henge, moreover, is much more probably a memorial circle, as its original name implies—"Stan Hengis" ; and commemorates the massacre of Vortigern's chiefs by Hengist in 462 A.D. The Rollright circle probably commemorates the victory of Rollo over Eadward, circ. 913, whilst Avebury and Hakpen (520), Kit's Coty House (455), Long Meg and her Daughters (508–520), Stanton Drew (508–520), Arthur's Table, Arbor Lowe, Cumrew, Salkeld and Mayborough commemorate some of the victories of Arthur. That this is reasonable may be mentioned the facts that coins of Claudius Gothicus (270 A.D.), Constantine the Great, Constantine junior, and Valentinian have been found at one or other.

Milverton, Leamington SAND. S. STANLEY

The Forecasting of Barometric Variations

IN a paper published in the *Journal* of the Royal Meteorological Society, vol. x., p. 219, 1884, I pointed out that during a series of years the barometric variations in Western India had presented certain features which, had they been known at the beginning of 1876, and, indeed, at the beginning of 1872, would have made it possible to have calculated with a considerable degree of precision and reliability the general course of the barometric variations from 1872 up to 1883, in some cases three months, and in some cases even twelve months beforehand. The facts brought forward in that paper were of such a nature that, as will be readily understood, I wished very much they could be found to occur generally. But it was undoubtedly better to restrict their application to the area and period dealt with in the paper. It having been shown, however, that at one period and over a certain area quantitative relations had existed between previous and subsequent barometric variations, it is natural to suppose that quantitative relations may be found to exist at other periods and over other areas also. The question arises, Can the facts brought forward in the above-mentioned paper serve as a guide to future investigation? I think to a certain extent they can.

The paper pointed out that there was a remarkable approach to an annual symmetry in the abnormal variations of the barometer in Western India during many of the years under observation. It supposed that this symmetry would have occurred every year during that period had it not been masked by larger variations of another character; and it was mainly by acting on this supposition and noting the departure from symmetry in any given year, and by considering that departure as being an index of the variation that was about to come, that the position of the barometer in the subsequent year was calculated. The paper attempted to explain the occurrence of this annual symmetry in two ways: (1) By supposing it to be a constant phenomenon connected with the annual double oscillation known to be present in the normal barometric curve; and (2) by supposing it to be a chance phenomenon, characterising a phase in the march of barometric variations, and persistent during the period dealt with, but not necessarily to be found in any other period. After further reflection I am inclined to believe that the latter is the correct explanation.

And here I think may be a guide to future investigation. It seems very likely that barometric variations may always be passing through phases which are persistent for several years. And, during the continuance of each phase the abnormal barometric curve will necessarily approach more or less to a certain annual type. In the cases dealt with in my paper that type chanced to be of a symmetrical form, sufficiently remarkable to strike the eye at once. The regularity of its form made it comparatively easy to be dealt with. An irregular type would of course be less easy to recognise and less easy to be dealt with. But it is obvious that if such types do exist and persist for several years in succession, then, by catching the type as the barometric phase comes in and by noting the departures from it each year, in a manner similar to that adopted with the symmetrical type I had to deal with, these departures may serve also in a similar manner as indices of the coming variations. Of course the methods of calculation would have to be purely arbitrary and specially devised for each barometric phase. If barometrical curves would yield to strictly mathematical methods, the problem of season-forecasting could be regarded as in a fair way of being solved. But it has never yet been found possible to resolve them entirely into regular periodical oscillations; and I believe they will always have to be arbitrarily dealt with.

Melbourne, July 21 A. N. PEARSON

Transmission of Sound

IN connection with the subject of mechanical telephones, which has been occupying public attention lately, there is a note by Mr. Miller in a recent number of NATURE, regarding certain experiments made in 1878 on the propagation of sound. With reference to this, Prof. Wernhold, of Chemnitz, writes to me, saying that as early as 1870 he had shown that human speech could be transmitted very distinctly through stretched wires or threads, and mentions that the results of his researches were published in an article on "The Transmission of Human Speech through an Iron Wire," in Carl's "Repertorium für Experimental Physik," Band vi., Serie 168. As your correspondent will probably like to refer to this, may I ask you to kindly publish this letter? W. E. AYRTON

Central Institution, Exhibition Road, London, October 12

Are there Rabbits in the Western Islands?

PROF. THOROLD ROGERS in his interesting book on "Work and Wages" mentions the relatively high value of rabbits in the thirteenth century, and suggests that they were then a recent introduction to England. It is well known that several islands on the west coast of Scotland have no rabbits upon them—for instance, Kerrera, which seems to point to the same conclusion. It would be interesting to know whether this is really the fact or not? HERBERT ELLIS

112, Regent Road, Leicester, October 4

THE HELL-GATE EXPLOSION

PROBABLY the largest chemical mechanical experiment ever thought of was successfully performed last week in New York Harbour by the removal of the obstruction known as Hell Gate, or Flood Rock, a considerable-sized island, as stated by the papers, about nine acres in extent, in Long Island Sound. The agent employed for this immense engineering work is a preparation or preparations of nitro-glycerine, and there is no doubt that this is the only explosive compound which could have been used for the purpose on account of the very enormous quantity required and the peculiar nature of the explosion of this substance. All the compounds or preparations of nitro-glycerine produce by explosion what are known as local effects only, as distinguished from gunpowder, the effects of which are much more gradually developed on ignition, but extend, owing to the slower and larger wave of disturbance, to a much greater distance. The legitimate use of nitro-glycerine is for purposes such as this, where a disruptive action is required.

The operations leading up to the final explosion have been some years in progress. They have consisted in forming a system of tunnels at a considerable depth under low-water level in the solid rock, and the charging of these tunnels with dynamite and mixtures known as rackarock, of nitro-glycerine with compressed gun-cotton. Twenty-four galleries were driven through this island, some of them 1200 feet long, and these were intersected by some forty-six others. These tunnels were about 10 feet high and 8 feet wide, and the roof of rock above them varied from 10 to 25 feet in thickness. The quantity of rock to be removed by the explosive was about 275,000 cubic yards, the quantity removed by tunnelling being about 80,000 cubic yards. A good deal of trouble has been occasioned during the course of the mining work by fissures, which have had to be stopped by wooden plugs in most instances. The explosive was charged into holes drilled into the roof and supporting walls and pillars at different angles, with a view to disrupt the strata of rock as much as possible.

The holes to be charged were about 9 feet in length and 2½ inches in diameter. The holes were charged first with the blasting gelatine or rackarock and filled to the ends with a dynamite cartridge, to which the detonator and electric wire were attached. In all fourteen thousand cartridges of a total weight of fourteen tons were employed. Near observers describe the explosion as being accompanied by a dull roar, but with only the slightest shaking of the ground, even at a moderate distance. An immense quantity of water was bodily raised up to heights estimated variously at 150 to 200 feet.

The results, as far as can be ascertained, are very satisfactory, the rock having been very thoroughly broken up, so that it can easily be dredged away.

After the example of an experiment on this scale, carried out without the least accident, perhaps it may occur to those in authority that we have on our own coasts dangerous rocks, not of the extent of Flood Rock, which might with immense advantage be similarly "chemically" removed.

Had gunpowder been the only explosive available, at least five times the quantity by weight of the nitro-glycerine preparations used in this experiment, would have been necessary and the results would not have been by any means so local or perhaps so satisfactory.

After this the engineer may find it to his advantage to cultivate more the acquaintance of the chemist and his products than has been hitherto the case.

SUBMARINE DISTURBANCE

THE following is an extract from the Meteorological log kept by Capt. R. J. Balderston on board the ship *Belfast*:—

"On December 22, 1884, at about ten minutes to 3 a.m., local ship's time, or 21d. 19h. 6m. Greenwich mean time, the ship *Belfast*, of Liverpool, was shaken by an earthquake which lasted from about 75 to 90 seconds. The vessel at the time was in latitude 34° 34′ north and longitude 19° 19′ west, the island of Madeira bearing true S.E., distant 145 miles.

"The shaking of the ship was accompanied by a loud rumbling noise, which, as heard from the cabin, resembled the sound which would be made by the rolling of large, empty, iron tanks about the decks, but which, as heard from the upper deck and in the open air, was as that of not very distant thunder, and it appeared to fill the whole of the air.

"I did not hear the commencement of the thunderous sound, and cannot say on what compass-bearing of the visible sky it commenced, but it travelled rapidly through the air and towards the S.W.

"The vibration of the vessel and the noise were greatest during the first 50 or 60 seconds; the former then died gradually away and ended in the very faintest tremor, while the latter, as it travelled south-westward through the atmosphere, died out with a low roar as it appeared to sink beyond the horizon.

"The helmsman found the steering-wheel much shaken as he held it, and in the cabins and cook-house, tin ware, crockery ware, and other light articles were rattled about.

"This little earthquake occurred three days prior to the commencement of the earthquake which caused so much loss of life and property in Spain.

"Meteorological Office, October 9"

THE BOTANICAL GARDENS IN JAVA

DURING the last few years so many useful and important improvements have been made in the botanical gardens at Buitenzorg and Tsi-Bodas that it might not be amiss if the attention of the readers of NATURE were again drawn to these valuable seats of systematic and philosophical research.

On entering the gardens at Buitenzorg the stranger is at once struck with the wealth and luxuriance of the vegetation he sees, the great height of the trees whose trunks and branches are in many cases covered with heavy creepers, the dense copses of the different species of bamboo, the eccentric-looking screw-pines and the handsome palm trees; but the scientific observer is also struck with the care that has been taken to arrange all these many varieties of tropical plant life in, as far as possible, their systematic order, and that each specimen has its scientific, and in many cases its Malay name also, clearly and distinctly printed on a little board by its side.

It is not difficult for any one to find his way about the garden, and in a very short time he can discover the particular family or group of plants which he may desire to study. Many families have probably more representatives in these gardens than in any in the world. The Sapataceæ, for instance, so rarely seen in Europe, are here represented by a great variety of genera and species, and the Palmaceæ, the Rubiaceæ, the Burseraceæ, the Orchidaceæ, and other families have now a large number of rare and interesting representatives.

The herbarium which is attached to the garden contains a large collection of dried plants and seeds collected together from the many expeditions into the little or unknown parts of the archipelago and from other sources. Attached to the herbarium there is a comfortable and convenient little library which contains most of the mportant botanical books and journals.

The laboratory, which, thanks to the energy of Dr. Treub, the director, is now completed, is a large, lofty and, for these climes, particularly cool room, and is well fitted out with reagents and apparatus for carrying on botanical research. The generous invitation which Dr. Treub has issued to naturalists and to which the attention of the readers of NATURE has already been directed has attracted several scientific men of different nationalities, and some excellent research has already been made in this laboratory.

When I arrived in Buitenzorg Dr. Treub was at Tsi-Bodas; so, after spending a few days in study in the gardens, I made the journey across the mountains to pay him a visit. The road from Buitenzorg to Tsi-Bodas crosses the Poenchuk Pass and is full of interest and beauty. On the way the traveller passes quite close to the Talaga Werner, the crater of an extinct volcano which is now filled with water, and forms a most beautiful little lake hidden in the dense foliage of the mountain slopes. The path from the road to the lake is through a dense wood of fine forest trees, and amongst the undergrowth is found many fine shrubs and plants which are not found in the low-lying country beneath.

The gardens at Tsi-Bodas are situated on the slopes of the Gedeh Mountains, at an altitude of 5000 feet, and here I found Dr. Treub at work in the comfortable little house which is attached to the gardens.

From this spot a very wide range of vegetation may be studied, from the rich and varied vegetation of the plains to the interesting vegetation of the Gedeh and Pangeranso peaks, at an elevation of 10,000 feet. In the gardens themselves a very fine collection of Coniferæ from America, China, Australia, and other parts of the world has been got together, and spaces have been cleared for the growth of the various species of Eucalyptus, Cinchona, and other plants. Year by year the surrounding forest is being encroached upon by these gardens to make room for new importations. I was extremely sorry that I could not prolong my stay at Tsi Bodas, but I had to return to Batavia to catch the Molucca boat. I saw, however, enough to convince me of the great importance of these gardens for the advancement of our botanical knowledge and the great opportunities they afford for research into all branches of the science.

I need hardly say that the climate in this region is extremely pleasant and invigorating, and the neighbouring village of Sindanlaya is much resorted to by Europeans and others whose health has suffered on the coasts or low-lying districts of the Archipelago. At Buitenzorg the climate is by no means unpleasant or unhealthy, but as it lies a few thousand feet lower than Tsi-Bodas, it is naturally a good deal warmer; but I am assured that several Europeans have worked there for several years without feeling their health the least bit affected.

It is hardly necessary to add that every one who has come over to Java to work in these gardens has been amply repaid for the time spent in the long journey over the sea, for the insight which can be gained here into what tropical botany really is is one which can be gained nowhere else in the world so well, and leaves an impression which is not likely to be forgotten in a lifetime.

Batavia, July SYDNEY J. HICKSON

ON CERTAIN NEW TERMS OR TERMS USED IN A NEW OR UNUSUAL SENSE IN ELEMENTARY UNIVERSAL GEOMETRY.

Point, Line, Plane, Space, Extension

A LINE may as usual be understood to mean a right line unless the contrary is stated.

Representable extension will comprise the concepts corresponding to the first four terms above written. So understood, the term *a space* is susceptible of a more precise meaning than is usually attributed to it: its *intrinsic* equation is given by Cayley's theorem of squared distances. It is a homaloid or flat of the 3rd as a plane is such of the 2nd, a line of the 1st, and a point of the *zero*th order.

The phrase *space of the 4th order* ought accordingly to be superseded if we would avoid using the same word in two different senses—*i.e.* in a wider and narrower sense. *Extension of the 4th* order is the proper expression to take its place, and so in general we ought to speak of *extension* of any given order n, and drop the phrase *space* of n-dimensions.

Figure, Plasm, Enclosure

A figure may exist in extension of any order. When pervasively limited by homaloids, simple and closed, I had proposed to give to it the *provisional* name of *plasm*, but Dr. Ingleby has supplied me with the more appropriate, or at least more simple, term, *enclosure*.

On the number and nature of simple regular enclosures in extension of any order, consult a remarkable memoir by Prof. Stringham * of the University of California (formerly of the Johns Hopkins University), in the third volume of the *American Journal of Mathematics*.

Homaloid, Flat, Niveau, Absolute Measure of Distance

Homaloid, the term long ago introduced by the writer of this note, *flat*, suggested by the late lamented Clifford, are now well understood, and need no new explanation; but it is well to bear in mind the *intrinsic equation* which serves to define them *to wit*

A homaloid in *extension of the nth order* is definable by means of an equation of the second order (naturally expressible in the language of determinants), in which $(n+1)$ points are the standards of reference, and the squared distances from these of any other point in the homaloid are the coordinates.

Observe that the squared length is the absolute measure of distance *between* two points. The distances of each *from* the other are not equal but opposite quantities differing in algebraical sign.

A *niveau* is a very convenient term to signify the *homaloid* of the *lowest* order that can be drawn through a given point-group and is always *unique;* the order of the homaloid which is the *niveau* to a group of n points cannot exceed $n - 1$.

Curves, surfaces, &c., of the 1st, 2nd, and *n*th *kind.*

A plane (or simple) curve is of the first kind; "a twisted curve," "courbe gauche," or a curve in extension of the 3rd order, of the second kind, and in general a curve in extension of the nth order is a curve of the $(n-1)$th kind.

Similarly we may define a simple surface as one of the first kind, and a surface in extension of the nth order as one of the $(n-2)$th kind; and so in general a figure of *variety i* † (i being 1 for a curve, 2 for a surface), in extension of the order n, is one of the $(n-i)$th kind.‡

* Mr. Stringham, a native of "the bloody land" of Kansas, studied mathematics and fine art under Peirce and Norton, at Harvard, obtained a fellowship at the Johns Hopkins University, and completed his studies under Klein in Leipsic. In his memoir he has given perspective drawings of the bounding solids about a vertex of the regular figures in quaternary extension, such solids being supposed to be previously rotated round the vertex into the same *space*, which of course may be done just as the bounding planes about a vertex of a regular figure in ternary extension may be rotated round that point into the same *plane*.

† A curve may be called a one-dimensional, a surface a two-dimensional, a solid a three-dimensional *continuum* and, and so on. Thus a *solid* is to a space what a *surface* is to a plane and a *curve* to a right line.

‡ The ordinary systems of geometry, whether Euclidian or Non-Euclidian (Ultra-Euclidian would be the more correct term), contemplate figures as contained in homaloids of some order or another; but this limitation has an empirical origin, and is not an essential ingredient of the pure theory of form; for instance, a curve, *i.e.* a *unidimensional continuum*, may, and in general will, be such as cannot be contained in a homaloid of any number of dimensions whatever; it might be said that the order of its *niveau* in such case is infinite; but this would be a mere verbal quibble—the right view being that it is *sans niveau*. The radical distinction therefore is not between the common Euclidian geometry and its generalisation (the so-called Non-Euclidian) but between the Homaloidal and the Anhomaloidal geometries.

Curve, Locus, Assembly, Envelop, Environment

A *curve* is that which is common to a locus of points and an assemblage of tangents; the locus is the *envelop* of the assembly, and the assemblage the *environment* of the locus.

Lines and Points

A line may be used in the double sense of a locus or direction. In the latter signification an Euclidian or objective line is the union of two lines running in contrary directions and an analytical line is a half-line, a "semi-droite," meaning, of course, a half-Euclidian line.

So a point may mean either a position or an infinite assembly of lines (containing or) contained in it; used in the latter sense, it might temporarily be termed a *pencil-point.*

There are half or split points, as there are half or split lines. Thus the infinite extremities of the asymptotes to a hyperbola are half-points, the union of two of them being the correspondent to a single point in any ellipse of which the hyperbola is a perspective image.

Coordinates, *Homogeneous and Correlated*

Homogeneous systems of coordinates may be distinguished into *absolute* and *proportional.*

In the former the absolute magnitudes of each are material, in the latter their ratios only.

Also into *direct* and *inverse.*

Direct coordinates are measured by given multiples of the distances of a variable point from fixed homaloids; inverse by given multiples of the distances of a variable line, plane, &c., from fixed points.

Correlated systems of direct and inverse coordinates are those in which my "universal mixed concomitant" (Clebsch's *connex*) $\xi x + \eta y + \zeta z$ (for greater clearness I confine myself for the moment to a particular diagrammatic case) equalled to zero expresses a line whose inverse coordinates are ξ, η, ζ, when these are made constant and a point (pencil-point) whose direct coordinates (when it is regarded as denoting position) are x, y, z when these in their turn are made constant.

If the distances of a point from the sides of the triangle of reference are l, m, n, and of a line from the angles of the *same triangle* λ, μ, ν, and if the direct coordinates being cl, dm, en, and the inverse ones $\gamma\lambda, \delta\mu, \epsilon\nu$, and the distances of the angles from the sides p, q, r—

$$c\gamma p = d\delta q = e\epsilon r.$$

l, m, n; λ, μ, ν are *correlated* systems.

If $l'\ m'\ n'\ p'$; l, m, n, p the direct coordinates of two corresponding points in a homography are connected by the Matrix M and $\lambda'\ \mu'\ \nu'\ \pi'$; λ, μ, ν, π (the inverse coordinates of two corresponding planes of the same homography) by the Matrix M', then if the two systems of coordinates are correlated, M and M' will be *opposite* matrices.*

Of course the like will be true in extension of all orders: thus *ex. gr.* in the case of a plane if for a given homography

$$l' : al + bm + cn$$
$$:: m' : dl + em + fn$$
$$:: n' : gl + hm + kn$$

Then

$$\lambda' : (ek - fh)\lambda + (fg - dk)\mu + (dh - eg)\nu$$
$$:: \mu' : (ch - bk)\lambda + (ak - cg)\mu + (bg - ah)\nu$$
$$:: \nu' : (bf - ce)\lambda + (ed - af)\mu + (ae - bd)\nu$$

* In other words, for two point-line, point-volume, &c., schemes homographically related, employing *correlated* systems of *proportional* coordinates, the matrix which serves to express the relation between the direct coordinates of the first scheme and those of the second may be taken the transverse of the matrix which does the same between the inverse coordinates of the second and those of the first. This is an important and as far as I am aware a new *theorem*.

provided that l, m, n; λ, μ, ν are *correlated* systems of coordinates.

Images: Reciprocals or Polar Reciprocals

It is very convenient to speak of any function which equated to zero expresses a figure as an *image** of such figure; thus *ex. gr.* $\xi x + \eta y + \zeta z$ may be spoken of as an image of the line ξ, η, ζ and of the point x, y, z.

A curve being the concept common to a locus and an assembly (the common ground, so to say, of the existence of each of them), will be capable of being imaged in terms of either direct or inverse coordinates. If the two coordinate systems are supposed to be correlated (as they ought always to be) then any two homogeneous functions which are reciprocal, or, let us say, conjugate to one another (each in common parlance the *polar reciprocal* of the other) will be images—the one of the curve under its aspect as a *locus*, the other of the very same curve under its aspect as an *assemblage*.

Reduced Perpendicular Distances

An extremely convenient system of homogeneous coordinates of a point is where each coordinate is the distance from one of the boundaries of the fundamental enclosure divided by the distance of that boundary from the opposite angle. Such coordinates may be termed coordinates of reduced distance or reduced coordinates; they are analytically defined by their sum being unity. If a, b be the two vertices which correspond to the coordinates of reduced distances, the squared distance of any two points, $x, y, z, \ldots$; $x', y' z', \ldots$ in extension of any order is capable of being expressed by the formula $\Sigma(ab)^2(x - x')(y' - y)$, which, as far as I have been able to ascertain, is nowhere stated in the books, except for the case of trilinear coordinates.

Exchangeable Figures

Two figures indistinguishable from each other by any of their internal properties, but incapable of occupying the same place (such as the left- and right-hand glove or shoe) have received the very awkward and misleading name of *symmetrical* figures; I propose to call them exchangeable figures, inasmuch as in the nature of things, as they are in themselves (without regard to the limitation of the human faculties), they may be made to pass into each other's places by a semi-revolution about a suitable homaloidal axis.

The Point-Pair at Infinity, Lines and Planes of Null

It has been already shown in these columns that the "absolute" in a plane has full right to be called the *point-pair* at infinity, in analogy with the received expression of the *line* at infinity, and those who have considered what has been here stated under the head of *reciprocity* will see good grounds for admitting that the line at infinity ought to be regarded as a complete line, *i.e.* as made up of two analytical "semi-droites."

Every line through either half of the absolute besides the property of being infinitely distant from any point in the finite region may be termed a *line of null*, in the sense that the distance between any two points in such line is zero.

In like manner any plane *touching* the absolute in extension of the 3rd order, besides being infinitely distant from the finite region, is in the same sense a *plane of null*; in it, form is divorced from content, for a figure of any shape being described upon such plane, its content will be *nil*.

Pluri-duality: Containing and Contained

In extension of i dimensions each continuum of λ dimensions stands in a relation of reciprocity to one of $i - \lambda - 1$ dimensions, the total number of these "dualities" being $\frac{i+1}{2}$ when i is odd and $\frac{i}{2}$ when i is even (in the former case the continuum of $\frac{i-1}{2}$ dimensions being its own reciprocal). It is very convenient in connecting reciprocal geometrical statements to ignore the difference between (and to regard as exchangeable and equivalent) the terms *containing* and *contained in* as applied to heterogeneous continua; indeed the ordinary distinctive use of these words suggests an erroneous conception; as *ex. gr.* of a line being *made up* of points or a plane of lines. A point may be said to contain every line or plane which passes through it, and a line every point which lies on it, and every plane which passes through it: as an example of this extended locution the order, rank, and class of a surface may be defined as follows—viz. the order and class as the number of its point and plane elements respectively contained in any given line; the rank as the number of its line elements contained in common by any given point and plane which contain one another.

A plane-section of a surface is the totality of its point- or line-elements contained in a plane and similarly a point-section (an enveloping cone), the totality of its plane- or line-elements contained in a point: hence indifferently the class of any plane-section or the order of any point-section of a surface is its rank.*

J. J. SYLVESTER

* When an *image* is given, its *object* is absolutely determined, but not *vice versâ*, since an image may be magnified or diminished at will by the introduction of a constant factor.

* The word *spread*, to signify an unlimited expanse of discontinuous points and so used by Dr. Henrici, is, I am informed, originally due to the late Prof. Clifford. In ignorance of this fact, on hearing that Henrici had been attacked for his use of the word, I stated my belief that it must have been borrowed from my use of it to signify a limited portion of a tissue of equi-spaced points, such as that which is turned to so profitable account in *my constructive theory of partitions* in the *American Journal of Mathematics*.

I did not know at the time that Clifford had used the word, nor that Dr. Henrici's treatise preceded by several years the publication of my memoir above referred to. This erroneous oral statement seems to have found its way by some more or less circuitous channel to the columns of the *Saturday Review* in a notice of a criticism, by Mr. Dodgson, of Dr. Henrici's geometrical manual in the Scientific Series. Dr. Ferrers (the Master of Caius College, Cambridge) was the first to apply a spread to demonstrate intuitively a celebrated arithmetical theorem of reciprocity due to Euler. Mr. Durfee a quarter of a century later led the way to a further and more pregnant use of the same by showing how to trisect a symmetrical spread bounded by two right lines and a broken line into a regular square and two quasi-triangular appendages, to which I superadded the notion of multisecting it into a succession of angles. Another pupil of mine at the Johns Hopkins University (Mr. Ely) has laid the foundation of a new theory of partitions, by studying the various modes of decomposing a *solid* spread of discontinuous points; his memoir on the subject is to be found in a recent volume of the *American Mathematical Journal*.

By means of the trisection method I obtained *inter alia* a new expansion of $(1 - xz)(1 - x^2z) \ldots (1 - x^2z)$, which, on making z unity and n infinite leads immediately to Euler's celebrated pentagonal-power series, and other results of a totally novel kind by the multisection method: so that a *spread* may justly be regarded as a potent instrument or magical mirror for extending old and bringing to view new truths in the *wonderland* of partition and elliptic-function series.

NOTES

ALL the five French academies will celebrate by a banquet the ninetieth anniversary of the foundation of the Institut, which was established on October 25, 1795, by the Conseil Législatif and Directoire Executif of the French Republic. The actual organisation is not quite the same as the original, great alterations having been made in 1814, and only partially abolished on subsequent occasions.

THE death took place last month of General J. J. Baeyer, President of the Central Bureau for European Triangulation and of the Royal Prussian Geodetic Institute. General Baeyer had reached the age of ninety-one years. A biography of some length will be found in the *Astronomische Nachrichten*, No. 2687.

M. ROBIN, a member of the Paris Academy of Sciences and of the French Senate, died last week. He had devoted his exertions to microscopy, and was professor to the School of Medicine.

By invitation of the Lieutenant-Governor of the Isle of Man Prof. Boyd Dawkins recently visited that island in order to report on its antiquities and the best means of preserving them. The result is given in a short communication to the Lieutenant-Governor, in which Prof. Dawkins indicates the present condition of the various classes of remains. He points out what should be done for their preservation, and advises that the island Legislature should pass an Act similar to the "Ancient Monuments Act" of the "neighbouring islands" of Great Britain and Ireland. The advice given by Prof. Dawkins is sound, and it is creditable to the Lieutenant-Governor that he has shown so much intelligent zeal in the matter. We are glad to note that he intends to follow up his action by introducing a bill into the Council with a view to carrying out Prof. Dawkins's recommendations.

The last publication of the Japanese Meteorological Observatory which has reached us contains the monthly summaries and monthly means for 1884, and is accompanied by forty-one maps, showing the isobars, isotherms, and prevailing winds. These volumes must demand unusual care on the part of the compiler, for they are printed in Japanese as well as English, and contain a mass of meteorological data of all sorts. We observe that three new stations have been added during the year, one in the north of Yezo, and the other, which should prove a valuable station, is at Fusan, the port of Corea recently opened to Japanese trade. This constant annexation of new territory by the Tokio Meteorological Bureau is to be highly commended.

A recent issue of *Cosmos* contains an account of the Jesuit establishments at Zikawei near Shanghai, the meteorological publications of which have frequently been noticed in Nature. The central establishment of the Jesuits in China is at Funkadoo in Shanghai, but about six miles away at Zikawei (Siccawei) they have a large adjunct, containing their schools, an orphanage, and a college. In the course of its existence the place has been twice sacked, but it was again rebuilt. In 1870 the fathers began with the rudiments of a meteorological observatory, of which Father Dechevrens was the founder, and has been to the present moment the director. Gradually, by purchase and by presentations from various Governments, the observatory became tolerably well equipped, and it is now a magnetic and meteorological station of the first order, making with excellent instruments observations on atmospheric pressure, temperature, humidity, evaporation, rain, winds, solar radiation, terrestrial magnetism in its various manifestations, &c. It issues a monthly *Bulletin* containing the observations, and a *résumé* and discussion of the meteorological events of the month. Thanks of the numerous missionaries scattered over the neighbouring provinces, who correspond with the director, the peculiar atmospheric movements in the China seas are beginning to be understood. Quite recently (as mentioned at the time in Nature) he has taken advantage, with the assistance of Sir Robert Hart, of the Telegraphs, to establish a regular daily weather service, for the benefit of mariners. The observatory is situated in a vast plain, where the horizon alone stops the view, and where atmospheric movements are not complicated by ranges of hills. A tower 33 metres in height has been erected, and the Beckley anemometer, constructed in 1884 by Munro, of London, is placed on a platform 7 metres higher. The observatory has gone on developing year by year, and there is little doubt that it will soon include in its field astronomical observations. The *Bulletins* are printed at the mission printing-press, which is included in the establishments at Zikawei, the printers being young Chinese. The monthly *Bulletins* form a considerable volume at the end of the year, and that for 1884, which has lately been issued, is the tenth in the series.

With regard to the new star in Andromeda Dr. Sophus Tromholt relates the following curious story in a Norwegian journal:—"When the interesting discovery had been made in 1877 that Mars was accompanied by two moons, it was shortly afterwards pointed out that Swift, in 'Gulliver's Travels,' relates that the Liliputian astronomers had discovered the two satellites (Voltaire, too, in a work in which he describes the experiences of two terrestrial beings on Mars, says that they saw the two moons unknown to mundane astronomers, but he has probably borrowed the idea from Swift). A similar remarkable proof that poets may also be prophets in astronomy has just come to light with regard to the new star in Andromeda. In the Hungarian periodical *Losonczi Phönix* for 1851 is a story by Maurus Jókai, the celebrated author, in which he refers to this star. Jókai makes an old Malay (?) relate that the Evil Spirit, Asafiel, revealed to King Saul and his sons the star in the nebula, and predicted that those who could not see it should perish in the impending battle. The Malay also reveals the star to his listeners and describes its position so accurately that there cannot be any doubt of the Andromeda nebula being the one referred to, although it is not named. The story, according to Jókai, rests on a biblical or Jewish legend. On the writer of these lines asking one of the greatest living authorities on biblical research whether the bible contains any reference to the point, he is informed that there is absolutely no such reference in that book, and that it is hardly possible that the nebula is mentioned in any Jewish legend. It is first mentioned by a Persian astronomer of the tenth century, and was first discovered in Europe in 1612. It would be exceedingly interesting to ascertain whether any Jewish tradition has preserved the mention of a star in the Andromeda nebula, as from this might be concluded that the new star is a variable one with a long period. I intend to inquire of Jókai whether his story is founded on any tradition or only an outcome of the author's imagination, but even should the latter be the case the story is a very curious one."

Algology is becoming a favourite science with some Russian botanists. After the valuable researches of Dr. Gobi on the algæ of the Gulf of Finland, several memoirs have been published by MM. Reinhardt and Rishavi on those of the Black Sea, and we find now in the last issue of the *Memoirs* of the Novorossian Society of Naturalists (ix. 2) an elaborate paper, by M. Reinhardt, being contributions to the morphology and classification of the Black Sea algæ. The paper is the first of a series. Following Bornet and Thuret's example given in their "Notes Algologiques," the author publishes his observations on separate species, without awaiting the time when he will be enabled to publish a more complete work. In the morphological part of his paper, M. Reinhardt discusses the development of a few Chlorophylleæ, and enters into more details with regard to some of the Cyanophyceæ, and especially the Phæosporeæ (the conjugation of *Ectocarpus siliculosus* and the growth of *Sphacelaria*). As to the Rhodophyceæ, only short remarks, especially as to pores in their external covering, are given. The chief attention has been devoted, however, to the Bacillariaceæ, and the paper contains a good deal of new observations on the structure of gelatinous colonies, the structure of the cell and its protoplasmatic parts, and the auxospores. The systematical part will appear in a next issue. The paper is accompanied by eleven tables engraved in Germany.

The same volume contains a very interesting paper on the development of Rotifers, by the Director of the Sebastopol Zoological Station, Miss Pereyaslavtseff. This subject has been rather neglected until now, and M. Zaleski's paper on the history of the development of the *Brachionus urceolaris* could not be considered as a complete solution of the question. Miss

Pereyaslavtseff's method differs from most of those hitherto recorded: she does not select one or another phase of development as being the most important, but, placing several Rotifers and Lepadellæ under the object-glass of a microscope, she waited until one of them would lay an egg, and the development taking about three days from the beginning of the segmentation until the issue of the new animal from the egg, she observed it continually throughout the first thirty to thirty-five hours, with only short interruptions of two to three hours in the observation of subsequent phases. This method has of course its inconvenience by preventing sleep for two nights. It cannot be applied also to those Rotifers which live an errant life. These last do not survive confinement, and must be kept in watch-glasses until they lay their eggs, which last are then brought under microscopic investigation. Ten different species were studied in this way, and proved to undergo the same development, so that *Rotifer inflata* has been given as a type of the development of the egg. The stages are all figured in forty-eight drawings on a plate accompanying the memoir.

THE same volume contains, moreover, three papers on geology: one by M. Sintsoff, on Tertiary fossils from Novorossia, being a description of the following new species: *Anodonta unioides*, *Scrobicularia tellinoides*, *Ervilia minuta*, *Neritina pseudo-Grateloupana*, and several others formerly described; it also contains a list of the fauna of the intermediate Ponto-Sarmatian deposits of the region. Another, by M. Miklashevsky, gives some information on the Government of Tchernigoff; and a third, by M. Andrusoff, deals at length with the geology of the Kertch peninsula, and throws some new light on the confused geology of the Crimea. It appears from the author's researches that the Tertiary deposits of the Crimea may be subdivided into the following: (*a*) the true *Congeriæ* deposits (Pontri), consisting of iron-bearing clays, equivalent in West Europe to the deposits of Hidas and Arpad, and of limestones, sandstones, and marls equivalent to the *Dreissena triangularis* deposits of the Vienna basin, the *D. rostriformis* deposits of Ploeshti and the upper Siebenbürgen deposits; (*b*) the Ponto-Sarmatian intermediate group of the Kertch limestone, equivalent to the lower Siebenbürgen deposits; (*c*) the Sarmatian group, equivalent to the same of Roumania, Turkey, and Austria-Hungary; and (*d*) the Upper Mediterranean, equivalent to the *Leythakalk*, the *Badner Tegel*, &c. It would result from the above, and from what is known about South Russia and the Crimea, that during the older Miocene period both were a continent. Later on they were invaded by a sea penetrating from the west, and a narrow gulf limited in the south by the Yaiba hills, extended towards the East. During the Sarmatian epoch the subsidence continued, followed soon by an upheaval towards the end of that period, which upheaval led to the formation of narrow, less settled bays, like those we see now on the Kuban, at the place formerly occupied by the Sarmatian Gulf.

The Garner and Science Recorder's Journal is the title of a new scientific monthly, edited by Mr. A. Ramsay, and published by W. E. Bowers, Walworth.

A SOCIETY for the Advancement of Science has been formed in Bergen, numbering about a hundred members, the President being Dr. Danielsen.

MR. ARTHUR S. PENNINGTON'S Manual of British Zoophytes, to be published immediately by Messrs. L. Reeve and Co., will include not only the Hydroida but also the Actinozoa and Polyzoa found in Great Britain, Ireland, and the Channel Islands. The same publishers announce an illustrative volume of "Collections and Recollections of Natural History and Sport," by the Rev. G. C. Green.

WE have received the sixteenth annual Report of the Norfolk and Norwich Naturalists' Society, forming part 1, vol. iv. of the *Transactions*. Amongst the published papers is a presidential address by Mr. Francis Sutton, F.C.S., on the nitrification of soils by means of minute living organisms; and the same gentleman also contributes a most valuable paper on the varieties of sugar, natural and artificial; Mr. Horace B. Woodward, F.G.S., gives a paper on the earthquake of April, 1884, which made itself so severely felt in the counties of Norfolk and Suffolk; Mr. F. D. Power, who visited the Norfolk coast during the period of the autumnal migration, in his "Ornithological Notes from Cley and Blakeney," shows the wonderful influx of birds, some of which are generally supposed to be of the greatest rarity, which takes place on the eastern coast at that period; amongst Mr. Power's list of rarities occurs the blue-throated warbler, of which he says he must have seen from eighty to one hundred individuals, and the barred and ictarine warblers. Mr. J. H. Gurney, jun., also contributes some valuable facts bearing upon the vexed question of migration, for the observance of which the Norfolk coast is so favourably situated. Mr. Southwold furnishes his usual review of the herring fishery from the ports of Yarmouth and Lowestoft, from which it appears that the enormous number of 505,005,600 fish were taken by the fishermen using those two ports; the same gentleman also contributes a paper on the white-beaked dolphin, a Cetacean which has been procured on several occasions on the east coast. The "Ornithological Notes" of Mr. Hy. Stevenson, F.L.S., are in continuation of a series extending back for many years; and a most interesting memoir of John Scales is contributed by Prof. Newton, forming one of a series of memoirs of naturalists of whom the county of Norfolk has since the commencement of the present century produced so many notable examples.

AN experiment has recently been tried at the Inventions Exhibition Aquarium by Mr. W. August Carter with a view to discovering how far fish are prone to sleep. After close examination he found that amongst freshwater fishes the roach, dace, gudgeon, carp, tench, minnow, and catfish sleep periodically in common with terrestrial animals. The same instincts were found to actuate marine fish, of which the following were observed to be equally influenced by somnolence—viz. the wrasse, conger eel, dory, dogfish, wrasse bass, and all species of flat fish. Mr. Carter states that, so far as he can discover, the goldfish, pike, and angler fish never sleep, but rest periodically. Desire for sleep amongst fish varies according to meteorological conditions. Fish do not necessarily select night-time for repose.

THE specimens of fish collected for the International Ichthyological Museum, which is being formed by the National Fish Culture Association, now number about 500. They include many rare fish as well as those of extraordinary growth and formation. Many of the specimens are the finest to be seen in London, having been specially caught for the Association by qualified ichthyologists and agents. The work of setting the fish out in glass jars is now being commenced, and it is hoped to be able to exhibit them to the public shortly.

WE have received the third and concluding part of Dr. Hann's paper before the Berlin Academy of Sciences on the temperature of the Austrian Alps. The tables contain monthly and yearly averages of temperature for 382 stations in the Austrian Alps and the neighbourhood reduced to the true (24-hour) average, and to a thirty-year period (1851–80). Of the stations 277 were below 1000 metres, 88 lay between 1000 and 2000, while 17 were over 2000 metres in height. The data obtained at all these stations over a period of years are here worked up and arranged. The present part contains over 160 pages, so that the whole paper would make a considerable volume dealing with temperatures in the Alpine regions of Austria.

M. D'ABBADIE begs us to state that the earth-tremors observed in his apparatus (NATURE, vol. xxxii. p. 568) about two miles north of the Spanish frontier coincided with the many earthquakes in the south of Spain. There were no such phenomena in Egypt.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Mr. L. C. Phillips; a Ring-tailed Coati (*Nasua rufa* ♂) from South America, presented by Lieut. W. F. Tunnard, R.N.; a Black Wallaby (*Halmaturus ualabatus* ♂) from South Australia, presented by Mr. R. E. Wootton Isaacson; a Javan Cat (*Felis javanensis*) from Java, presented by Capt. T. H. Franks; a Puma (*Felis concolor* ♂) from South America, presented by M. Rodolfo Aranz; two West Indian Rails (*Aramides cayennensis*) from Brazil, presented by Mr. J. C. Fraser; a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, presented by Mr. H. D. Astley, F.Z.S.; a Silver Pheasant (*Euplocamus nycthemerus*) from China, presented by Mrs. James; three Robben Island Snakes (*Coronella phocarum*), a Hoary Snake (*Coronella cana*), a —— Elaps (*Elaps hygiæ*), a Reddish Pentonyx (*Pelomedusa subrufa*) from South Africa, seven Geometrical Tortoises (*Testudo geometrica*) from the Orange River, South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; a Blue and Yellow Macaw (*Ara ararauna*) from Trinidad, received in exchange; eight Summer Ducks (*Œx sponsa*, 4 ♂ 4 ♀) from North America, purchased; a Bennett's Wallaby (*Halmaturus bennetti* ♀), born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, OCTOBER 18–24

(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 October 18

Sun rises, 6h. 31m.; souths, 11h. 45m. 9·9s.; sets, 16h. 59m.; decl. on meridian, 9° 47′ S.: Sidereal Time at Sunset, 18h. 48m.

Moon (two days after First Quarter) rises, 14h. 51m.; souths, 20h. 0m.; sets, 1h. 17m.*; decl. on meridian, 10° 27′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	6 37	11 51	17 5	9 43 S.
Venus ...	10 37	14 30	18 23	23 26 S.
Mars ...	0 6	7 38	15 10	16 38 N.
Jupiter ...	3 35	9 54	16 13	3 5 N.
Saturn ...	20 41*	4 49	12 57	22 17 N.

* Indicates that the rising is that of the preceding and the setting that of the following day.

Phenomena of Jupiter's Satellites

Oct.	h. m.		Oct.	h. m.	
21	4 32	I. tr. ing.	22	4 10	I. occ. reap.

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Oct.	h.	
20	0	Saturn at least distance from the Sun.
20	13	Saturn stationary.

GEOGRAPHICAL NOTES

THE work done by Lieut. Wissmann in his exploration of the Kassai River, the great southern tributary of the Congo, is second in importance only to the discovery of the Congo itself. It will seriously modify the conjectural geography of that part of Africa. He found the river to be of immense volume, and navigable from its junction with the Lulua. He found the Sankuru and the Lubilash to be one river, which, instead of flowing northwards to the Congo, turns westwards, and joins the Kassai. As it approaches the Congo Kassai receives the great Koango, and enters the main river by the Kwamouth, after receiving the water of Lake Leopold. Thus the river which on Stanley's last map joins the Congo west of Stanley Falls cannot be the Lubilash, and, moreover, must be of no great length. This discovery of Lieut. Wissmann, along with that of the Mobangi by Mr. Grenfell, greatly increases the navigable waterway of the Congo system.

THE September number of *Petermann's Mittheilungen* has for its principal article the first part of an account of Paulitschke and Hardegger's journey to Harar, by Dr. Paulitschke. It is accompanied by a map of the districts traversed. The present instalment describes the circumstances under which the journey was undertaken, the preparations at Zeila, where the English consul was able to put the travellers in friendly communication with Abu Bakr, the Governor of Zeila, who gave them the most important help, and the details of the journey as far as Bussa, on the frontier of the Northern Gallas country. Dr. Schinz asks the question whether Namaqua-Land or Nama-Land is correct, and decides in favour of the latter. "Namaqua" is a Dutch corruption; the term "Nama" is applied to Hottentots in general, without any distinction of sex; "namaqua" is properly "namagu" or "namaga," the nominative and dative plural of "nama"; "qua" is therefore doubly wrong as a suffix, and Namaland is the proper term. M. Rabot writes on the Stor Börgefjeld in Nordland in Norway, and the usual literary and geographical news brings the number to a conclusion.

THE last number (Band xxviii. No. 29) of the *Mittheilungen* of the Geographical Society of Vienna contains a paper on the ethnic members of the western Somali and north-eastern Galla tribes, by Dr. Paulitschke, accompanied by a map; six letters from Dr. Lenz on his Congo expedition, and the first part of a paper by Herr Jülg on the erosive action of the sea on coasts; the bibliography of Africa for the last half year, and the usual notices of geographical works conclude the number.

M. BRAN DE SAINT POL-LIAS, who was sent on a scientific mission to Tonquin and Java, returned to France towards the close of September. He brought back with him numerous specimens of the flora and fauna of the districts through which he travelled.

THE chief geographical societies in Germany have resolved to erect a monument to the late Dr. Nachtigal on Cape Palmas, where he lies buried. It is intended to have it so large that it will serve as a landmark to seamen.

THE Godeffroy Museum at Hamburg, illustrative of the natural history of the South Sea Islands, has been sold to the Ethnographical Museum of Leipsic.

THE GREAT OCEAN BASINS[1]

I.

THE ancients, down to the time of Aristotle—and most of them for a long time afterwards—regarded the earth as a great plain surrounded on all sides by the mighty, deep, gently-flowing stream of the ocean.

In the geography of the Homeric age there was not supposed to be any communication between the Mediterranean and this all-encircling ocean river. When, in consequence of the excursions of the Phœnicians, the communication through the Pillars of Hercules became known, ideas respecting the outer sea gradually changed. At first, curiously enough, the Atlantic Ocean was regarded as muddy, shallow, and little agitated by the winds—a belief apparently associated with the supposed subsidence of the legendary island of Atlantis. The world, as known to the ancients down to about 300 years before Christ, is represented in this map of Hecatæus.

There seems to be no doubt that the spherical form of the earth was known to some philosophers even before the time of Aristotle—the proof that the earth is a sphere being indeed easy to minds that had received a mathematical training—but these have been few in all ages, and an idea so directly opposed to the apparent evidence of the senses could only be expected to win its way with difficulty. Indeed, at the present day the majority of even educated people are unable to give any reason for their belief that the earth is a sphere, other than that navigators are now in the habit of sailing around it.

[1] Lecture delivered at the Aberdeen meeting of the British Association by Mr. John Murray, Director of the *Challenger* Reports.

However, we find that Erathosthenes, Posidonius, and other learned Greeks, who flourished between one and two centuries before our era, were in possession of ideas concerning the figure and position of the terrestrial globe which do not differ materially from those of the modern geographer. They had considerable knowledge of the great wide sea, a clear perception of the diurnal recurrence of the tides, of their monthly cycles of variation, and correctly ascribed these changes to the influence of the moon. They speculated on the circumnavigation of the globe, and thus anticipated by many centuries the project of Columbus of sailing direct from Spain to the Indies.

During the century immediately preceding the Christian era, and during the dark and middle ages, there was a large acquisition of information with respect to the superficial extent of the ocean. But, when we look back on the history of knowledge concerning our planet, there is to be found no parallel to the impression produced in men's minds and conceptions by the discovery of America, and the circumnavigation of the world, a few years later, by Magellan and Drake. The influence of these events and the great ideas associated with them, can be traced throughout the literature of the Elizabethan period; Shakespeare appears to have had the mental picture of the great, solid, floating globe continually before him. His spirit seemed

> ". . . . blown with restless violence round about
> The pendant world."

To the great mass of people the circumnavigation of the globe was the practical demonstration that the earth was swung in space, supported alone by some unseen power; it was the conclusive proof of its globular form—a fact which must be regarded as the fundamental principle of all scientific geography.

The rage for geographical exploration which set in after the discovery of America brought the phenomena of the ocean into greater prominence, but the science of the sea can hardly be said to have commenced till the seventeenth century, when Hooke and Boyle undertook their experiments as to the depth of the sea and the composition of ocean water; and several naturalists gave descriptions of the animals and plants inhabiting the shallow waters surrounding the land. During the eighteenth century there was again a large acquisition of knowledge concerning the ocean, for the navigator was busy with the study of the winds, currents, and tides; while the two Rosses with other explorers and scientific men made most praiseworthy endeavours to investigate the greater depths of the sea during the first half of the present century.

The vast abysmal regions of the great ocean basins, however, lay all scientifically unexplored, when about twenty years ago their systematic examination was undertaken by expeditions sent forth by our own country and by the Governments of the United States, Germany, Italy, France, and Norway.

It is not easy to estimate the relative importance of the events of one's own time, yet in all probability the historians of the reign of Victoria will point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge, as among the most brilliant conquests of man in his struggle with nature, and doubtless they will be able to trace the effect of these discoveries on the literature and on the philosophic conceptions of our age. A mantle of mystery and ignorance has been cleared away from the eleven-sixteenths of the earth's surface covered by the ocean, and in its place we have much definite and accurate knowledge of the depths of the sea. The last of the great outlines showing the surface features of our globe have been boldly sketched; the foundations of a more complete and scientific physiography of the earth's surface have been firmly laid down.

This evening we will endeavour to pass in review some of the chief phenomena of the great ocean basins, and attempt to bring before you some of the more important results arrived at by the many distinguished men who have been engaged in oceanographical researches during recent years.

If it be remembered that the greatest depth of the ocean is only about five miles, and that the height of the highest mountain is likewise about five miles above the level of the sea, while the globe itself has a diameter of 8000 miles, the comparative insignificance of all the surface inequalities of the earth is at once forced on our attention. A circle 66 feet in diameter having on its surface a depression of one inch; or a globe one foot in diameter, with a groove on its surface one-sixtieth of an inch in depth, would represent on a true scale the greatest inequality, of mountain height and ocean deep, on the surface of the earth. Misconceptions often arise, and erroneous conclusions are frequently arrived at when these proportions are not rigidly borne in mind. But, unimportant as these surface features may appear when viewed with reference to the diameter of the earth, or to the superficial area of an ocean several thousand miles in extent, still to the geologist and physical geographer the elevations and depressions, foldings and dislocations, vertical and lateral, which form these inequalities are truly gigantic, immense, profound; and the more they are studied the more do they appear to be the result of changes taking place in a very definite and orderly manner in the course of the earth's developmental history.

Allow me to direct your attention to the maps representing hemispheres of the earth drawn in equal surface projection. The continental land of the world is coloured black, the abyssmal regions are coloured red, and between these two there is a border or transitional area which is uncoloured.

You will observe that the dark-coloured masses of continental land are, at some one point, more or less closely connected with similar masses; there is usually a place where adjacent masses are not separated by oceans of very great depth. A traveller might almost journey from any one point in these regions to any other without once losing sight of land. If an exception must be made to this statement it is in the case of New Zealand and the Antarctic Continent, for the *Challenger's* dredgings, which brought up masses of schist, gneiss, granite, sandstone, and compact limestone along the borders of the ice-barrier, show beyond all doubt that there is a mass of continental land at the south pole, but, since it is buried beneath perpetual snow, its exact extent is a matter of conjecture.

The surfaces of the continents are everywhere cut into cliff and gorge, mountain and valley, and are continually undergoing a process of disintegration. Water, frost, ice, sudden changes of temperature, are ever tearing the solid rocks to pieces, rivers are transporting the fragments down to the ocean, or carrying away the solid earth in solution; the bulk of this material is deposited in the areas bordering the continents—the uncoloured areas on the maps—there to form rocks which may once again become dry land. Sooner or later the whole of the continents would in this way be reduced below the level of the waves, were not other forces at work producing elevation. Such forces there are, and they are probably more potent than the disintegrating and transporting forces, since there are many reasons for believing that there is now more dry land than at any other period of the earth's history.

The continents have an average height of about 900 feet above the level of the sea; they may be regarded as elevated plateaus occupying five-sixteenths of the earth's surface.

The abysmal regions of the earth, represented by the red colour on the maps, occupy eight-sixteenths, or one-half of the earth's surface, and have an average depth of three miles beneath the surface of the waves. The greatest depths in the Pacific are to the south and east of Japan, where there are abysses of over five miles; and in the Atlantic the greatest depth is to the north of the Virgin Islands, where there is a depression of a little over four miles.

From all we yet know of these abysmal areas they have not a diversity of peak, gorge, mountain, and valley comparable to those which are met with on land; they are fundamentally areas of deposition. It is true that the close soundings of telegraph engineers appear to show that in some cases there may be steep cliffs in the shallower depths of the ocean in volcanic areas; yet the general aspect of the abysmal regions must be that of vast undulating plains, interrupted here and there by huge volcanic cones, with slopes at a very low angle. When these cones rise above the surface they form volcanic oceanic islands. When they rise nearly to the surface they are, in the tropics, often capped by coral atolls; but many of them are far beneath the waves and are covered by a white mantle of carbonate of lime—the dead shells and skeletons of pelagic and deep-sea organisms.

The land of the oceanic islands is of small extent and differs widely in the nature of the rocks, as well as in the character of the terrestrial and marine fauna and flora, from the continents and continental islands. There has not been found in the abysmal areas any land made up of gneisses, schists, sandstones, or compact limestones; nor have fragments of these sedimentary formations been found in the erupted rocks of the volcanic islands, though they are frequent in the volcanic eruptions on the continental areas.

We may, indeed, compare the oceanic islands to the fresh and salt water lakes scattered over the surface of the continents and cut off from direct communication with the ocean. These lakes differ as much from the waters of the ocean as do the oceanic islands from the land of the continents.

The surface of the earth may then be divided into three great regions—the abysmal area, occupying, so to speak, the bottom of the basins, covering one-half of the earth's surface; a border region occupying, so to speak, the sides of the basins, covering three-sixteenths of the earth's surface; and lastly, the continents which cover five-sixteenths of the earth's surface. The average height of the elevated plateaux of the continents above the submerged plains forming the abyssmal regions is fully three miles.

When we pass to a consideration of the water of the ocean, which fills these great hollows of the earth, it is essential to take account of the superincumbent atmospheric ocean, which everywhere rests on its surface, for the composition of the ocean water, the currents, the distribution of salinity, density, temperature, and even that of deep-sea deposits, are largely determined by the movements of the atmosphere.

One of the most important parts played by the ocean in the economy of the globe is to bring about a more equable distribution of temperature by the winds which blow from it over the land and by means of the oceanic currents that are originated and maintained by the winds.

From the smallness of the *daily* variation of the temperature of the surface of the sea, which are shown by the *Challenger* observations, as discussed by Mr. Buchan, not to exceed 1° F., as compared with the large daily variation on land, there result directly the land and sea breezes with all their beneficial consequences. Similarly from the small *yearly* variation of the temperature of the sea, as compared with the very large variation of the temperature of the land surfaces of the globe, result those great annual changes of the prevailing winds—the most important of which, with respect to widespread climatic effects, is the summer monsoon of the Europeo-Asiatic continent.

But the most important, as well as the most direct, effect of the unequal distribution of temperature over the surfaces of the oceans and continents, is an unequal distribution of atmospheric pressure varying more or less with season. On the one hand, in a particular season we see a portion of the earth's surface with atmospheric pressure much less than in surrounding regions, and as long as the low pressure is maintained the winds from the regions all around continue to blow inwards upon it, bearing with them the temperatures and humidities of the regions from which they have come. On the other hand there are other parts of the earth's surface with atmospheric pressure much higher than in adjoining regions, and, as this state of things continues with little variation throughout the year, the winds blow out in all directions towards surrounding regions. Of this two illustrations may be given.

During winter months atmospheric pressure is much less in the North Atlantic about Iceland than it is all round, and towards this area of low pressure the winds from the surrounding continents blow vorticosely, thus determining the winter climates of the more important countries of the world. Over Canada and the United States the winds are north and north-westerly, by which the rigours of winter are intensified; but in Western Europe the prevailing winds are south-westerly, and, as these winds bring with them the warmth and moisture of the Atlantic, the winter climates of Western Europe contrast strongly, latitude for latitude, with those of the eastern states of America.

Again, pressure is higher in the Atlantic between the north of Africa and America than it is all round, and out of this anticyclonic area of high pressure observations show that the winds blow in all directions towards surrounding regions where pressure is less. To the westward of North Africa the prevailing winds are northerly and north-westerly, but on the south side of this anticyclonic region the winds are easterly, and on the west the winds are southerly.

Owing to these very different winds, and the oceanic currents to which they give rise, the temperature of the sea is much higher off the coasts of Florida than it is off the coasts of Africa in the same latitudes. The effect of these differences is recognisable in the distribution of marine life and coral reefs, and, consequently, of the deposits at the bottom of the sea.

Since over this anticyclonic area, and similar ones in the South Atlantic, North Pacific, and in a less marked degree in the South Pacific, atmospheric pressure remains high throughout the year, notwithstanding the outflow of wind all around from them, it follows that aërial upper currents must flow towards these high pressure regions accompanied by a slow downward movement of the air through their central portions. Now, as observations show that in such circumstances the sky is clear, the air dry, the rainfall small, and the evaporation large, it follows that over these parts of the great oceans, where atmospheric pressure is higher than all around, the rainfall is very far from being sufficient in amount to make good the loss arising from evaporation—a consideration which has important bearings on the difficult question of oceanic circulation.

As in these anticyclonic regions in the great oceans there is opened up a direct communication between the upper regions of the atmosphere and the surface of the sea, by means of the descending aërial currents, it is interesting to ask whether this fact may not have some connection with the volcanic and cosmic dust found in the same regions in the deep-sea deposits; especially is this interesting in connection with recent speculations as to the presence of these substances in the higher regions of the atmosphere.

In thus indicating the positions of the high-pressure areas, and of the winds that blow out from and around them over the great oceans, we have at the same time traced the courses of the great oceanic currents and the positions of the Sargasso seas, for the winds everywhere determine and control the movements of the surface waters.

The moisture taken up from the sea surface by the winds—leaving the water salter than before—is borne to the land and condensed on the mountain-slopes. Eventually this water gathers off the land, passes by rivulet, stream, and river down again to the ocean, bearing along with it a burden of earthy matters in solution. In this manner the ocean has most probably become salt in the course of ages. The water of the ocean now contains, it is almost certain, a portion of every element in solution. Many of these are present in exceedingly minute traces. They are detected either in the sea water or the evaporated-down residue by spectrum analysis; in the copper of ships' bottoms, which have withdrawn them by chemical decomposition; or, again, in the ashes of sea-weeds and marine animals, which, during life, exert a selective influence upon the surrounding water.

(A diagram was exhibited showing the average composition of sea salt.) The individual salts present in sea water are, of course, constantly interchanging their metals and acid radicals, so that it is impossible to say authoritatively what is the precise amount of the respective chlorides and sulphates of sodium, potassium, calcium, and magnesium actually present. But it has been shown by hundreds of laborious and most delicate experiments that the actual ratio of acids and bases in sea salts—that is, the ratio of the constituents of sea salts—*is constant* in waters from all depths, with one very significant exception—that of lime—which is present in slightly greater proportion in deep water.

The total amount of dissolved salts in the ocean would, it is calculated, if extracted, form a pavement 170 feet thick over the entire sea-bed, and of this amount $1\frac{1}{4}$ inches would be composed of pure carbon, chiefly present as carbonic acid in the carbonates.

On account of the constancy in its composition the determination of any one of the constituents of sea salt—chlorine, for instance—gives the datum for calculating the salinity—that is, the proportion of total salts to the water in which they are dissolved; though determinations of this nature are more conveniently made by observations of density by means of the hydrometer. (A map was exhibited on which Mr. Buchanan has shown the results of his laborious investigations in this direction.) An examination of this shows that the surface water of the ocean is freshest—that is, contains the least salt—at the poles and in the equatorial belt of calms. In the east of the Indian Ocean a change of the monsoons brings about a great change in the salinity of the surface water. The centres of the great systems of oceanic currents produced by the trade winds are the areas of highest salinity in the open ocean; yet here the water is not so salt as in some enclosed seas situated in areas of great evaporation, as the Mediterranean, and especially the Red Sea and Persian Gulf, where the saltest water is found and where a regular circulation is kept up by the outward flow of the denser water. The salinity of the deeper waters is considerably below the average at the surface in the open ocean, especially in the Atlantic.

In the equatorial regions the surface water of the ocean has occasionally a temperature of 85° or 86° F., and the normal temperature in tropical and sub-tropical regions ranges from 60° to 80°. This warm water is, however, a relatively thin stratum on the surface, the great mass of the ocean consisting of cold water—water of 45°, 40°, and of even a much lower temperature. At a little over half a mile of depth in the tropics the water has a temperature of 40°, and at the bottom it is still colder—ice-cold indeed. The ooze which is dredged from the bottom beneath the burning sun of the equator is so cold that the hand cannot be held in it for any time without great discomfort.

In the open ocean the temperature usually decreases with the depth, the coldest water being found at the bottom; but sometimes there are limited areas where the temperature remains uniform for a mile or half a mile above the bottom. This has been shown to depend on the existence of barriers to free circulation, which exist on the floor of the ocean, and cause in a measure a resemblance to the conditions which are so marked in many partially enclosed seas, shut off by submarine barriers from general oceanic circulation, where the temperature is uniform, it may be, from a few fathoms below the surface to the bottom—for instance, in the Mediterranean and Seas of the Malayan Archipelago.

The low temperature of deep ocean water was acquired at the surface in high latitudes, chiefly in the high latitudes of the southern hemisphere. The salt warm water of the tropical regions, which is driven in relatively rapid currents along the eastern shores of South America, Africa, and Australia by the action of the prevailing winds, on reaching a southern latitude of 50° or 55° sinks on being cooled, and spreads over the floor of the ocean. A similar circulation takes place in the northern hemisphere, though modified in many ways by the peculiar configuration of the land: for instance, it is almost certain that the cold water at a temperature of 30° F., which occupies the deeper part of the Norwegian Sea beyond the Wyville-Thomson Ridge, is the dense surface water of the Atlantic, which becomes cold and sinks as it passes northward in the extension of the Gulf Stream. Again, the relatively low temperature found on the eastern coasts of Africa and America seems largely due to the cold deep water which is drawn up to supply the place of the warm surface water driven forward by the trade winds.

While surface currents, both warm and cold, have at times considerable velocities, there is no evidence that rapid currents exist anywhere in the great deeps, on the contrary, the movements must be extremely slow and massive in character; the only exception seems to be on the crests of some ridges at moderate depths between volcanic islands or other similarly situated places.

Through the constant circulation in the ocean the gases of the atmosphere, which are everywhere absorbed at the surface of the sea according to the known laws of gas absorption, are borne down and thus enable myriads of living organisms to carry on their existence at all depths. The nitrogen remains at all times and places nearly constant, but frequently the proportion of oxygen is much reduced in deep water, owing to the processes of oxidation and respiration which are there going on.

The absorbed carbonic acid plays a most important and intricate *rôle* in the economy of the ocean, owing to its tendency to reduce normal carbonate of lime and magnesia to solution in the form of bicarbonate; and to the rapid interchanges to which it is subject in consequence of vital processes. It probably receives large additions from the bottom of the ocean, as an after-product of volcanic eruptions, and through the respiration of animals.

It is often supposed that hydrochemical actions go on with much greater activity in the deep sea where there may be a pressure of four or five tons on the square inch, but, while it would be convenient to assume it, there is no sufficient evidence that such is the case. The disintegrations, decompositions, and depositions which take place in the deposits are all similar to those which take place in shallow water or on land, and any chemical peculiarities occurring in inorganic or organic substances in great depths are probably due chiefly to the low temperature, almost perfect stillness, and the absence of light: for, although it may be admitted that some rays descend to much greater depths in the sea than is usually supposed, yet we must at present believe that none of them reach the greatest depths. The absorbed gases are probably but little affected by the great pressure of the superincumbent water, for in this connection it should be remembered that water is but little compressible; any substance which will sink to the bottom of a tumbler of water will in time sink to the bottom of the deepest ocean; this is true at least for all substances which are more compressible than water itself. The compressibility of water cannot, however, be neglected in oceanographical questions. In very great depths the lower layers are considerably compressed; for instance, in an ocean five miles deep, were the action of gravity suddenly to cease, the water would rise about 500 feet above its present level from expansion, a height sufficient to submerge nearly all the habitable land of the globe.

It remains to mention the investigations, which have recently been made, as to the change of level of the ocean, owing to the attraction of the masses of continental or other land—such, for instance, as that of the Himalayas for the water of the ocean to the south, by which the level of the Southern Indian Ocean is lowered some hundred feet; the bearing of this on the apparent elevation or submergence of land along coast-lines is evident, for the level of the sea, to which we refer all heights and depths, cannot be regarded as much more stable than the solid land itself.

(*To be continued.*)

NEW PROCESS OF LIQUEFYING OXYGEN [1]

LIQUID ethylene, the preparation and use of which I have already explained, shows, at its boiling-point under the pressure of the atmosphere, a temperature of at least − 103° C., only some 10° from the critical temperature of oxygen (− 113° C.). It is understood how in the expansion of compressed and cooled

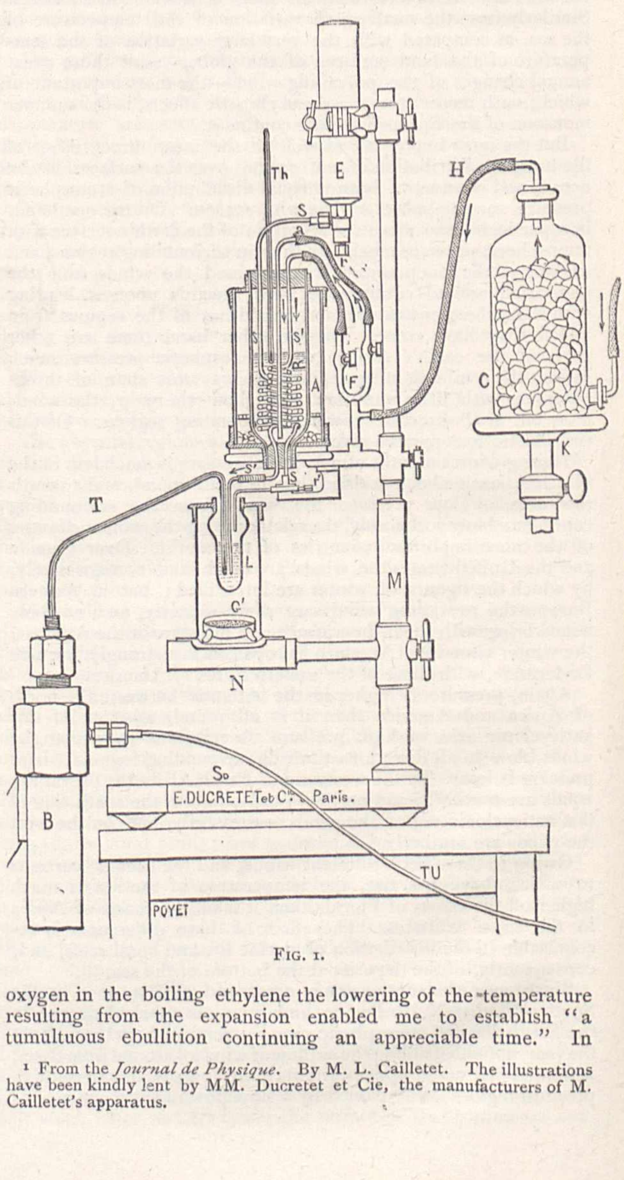

FIG. 1.

oxygen in the boiling ethylene the lowering of the temperature resulting from the expansion enabled me to establish "a tumultuous ebullition continuing an appreciable time." In

[1] From the *Journal de Physique*. By M. L. Cailletet. The illustrations have been kindly lent by MM. Ducretet et Cie, the manufacturers of M. Cailletet's apparatus.

regulating the expansion so as to maintain a certain pressure in the tube, the oxygen is seen for some time completely liquefied.

When by means of the air-pump the evaporation of liquid ethylene is accelerated, as was done by Faraday with protoxide of nitrogen and carbonic acid, its temperature is reduced much below the critical point of oxygen.

With a view to avoiding the inconveniences and complications involved in the necessity of working *in vacuo*, I indicated liquid *formène*, which with the greatest ease achieves the liquefaction of oxygen and nitrogen. Notwithstanding these advantages, in consequence of the perfection to which I have recently brought the preparation and management of ethylene, it has seemed to me that this substance should be preferred to formene, and so, by means of boiling ethylene in open vessels, I have succeeded in obtaining a temperature sufficiently low for the complete liquefaction of oxygen.

The preparation of ethylene by means of sulphuric acid and alcohol is frequently impeded by the frothing of the material, terminating the experiment before the gas has been completely liberated. The admixture of sand, recommended by Wöhler, does not always serve to counteract this frothing, but I have found the addition of a small quantity of vaseline efficacious in this respect.

The material I work with consists of 400 grammes of alcohol, 2000 grammes of sulphuric acid, and 15 to 20 grammes of vaseline. This is warmed in a glass globe, of 5 or 6 litres capacity, over a burner in the usual way. The gas is washed in two large flasks of caustic soda, and then collected in a water gas-holder. By means of a mercury pump the ethylene is dried by passing through a flask of sulphuric acid and condensed in steel bottles having a screw tap.

Fig. 1 represents the apparatus I made use of to liquefy oxygen by the rapid evaporation of ethylene by means of a current of air or of refrigerated hydrogen. The liquid ethylene is inclosed in the bottle E, which is fixed to a vertical support, with its mouth directed downwards, and is in communication with a copper worm, S S, of 3 mm. to 4 mm. in diameter, closed at its lower extremity by a screw cock, *r'*. After the worm has been cooled to $-70°$ by means of chloride of methylene in the manner I shall explain further on, the ethylene there accumulating possesses at this temperature but a weak tension, and it may therefore be run without sensible loss into the test-tube, L, when the cock, *r'*, is opened. This new arrangement I have adopted for ethylene and formene allows the liquefied gas to be cooled as well as though the whole reservoir containing it were of the same temperature as the worm.

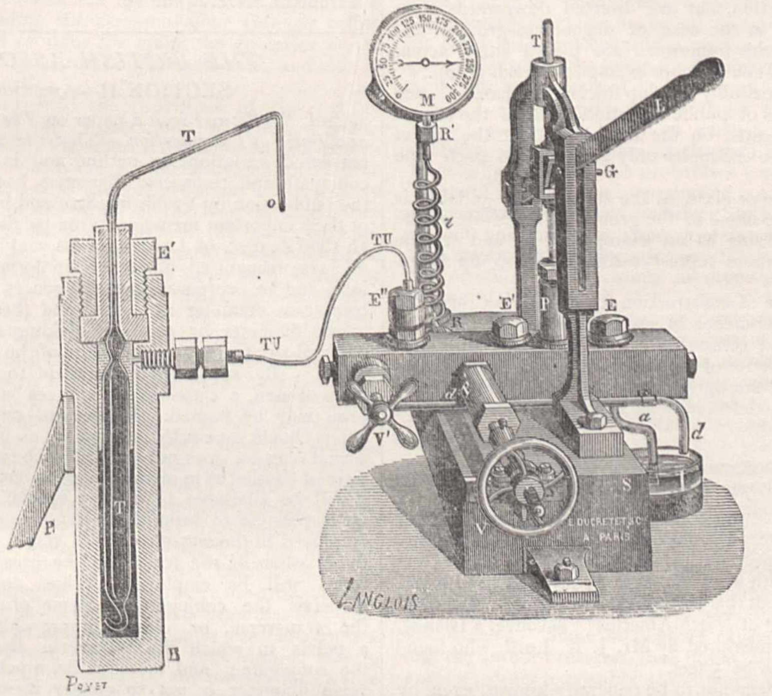

FIG. 2.

The glass test-tube L is arranged in a vessel containing, air dried by means of pumice and sulphuric G', and in this way hoar-frost is prevented from being deposited on the refrigerated sides.

When the ethylene has been received in the test-tube L, its evaporation is accelerated by passing through it a current of air, or, still better, of hydrogen dried by its passage in the vessel C, containing chloride of calcium, and cooled in the worm S'.

The two worms in which the air and the ethylene circulate are plunged into chloride of methylene which is rapidly evaporated by means of dry and cool air, and in this way a temperature of $-70°$ is obtained.

Fig. 2 shows the arrangement of the oxygen apparatus and the compression pump. When the tube *To* is plunged into the ethylene, the evaporation of the latter is accelerated by gently opening the cock F, and blowing on to it the air or hydrogen cooled in the worm S'.

The pump is then brought into action, and the oxygen resolves into a colourless, transparent liquid, separated from the gas surmounting it by a perfectly sharp meniscus.

By means of a hydrogen thermometer, the construction of which I shall shortly explain, I have measured the temperature of the ethylene, which in one of my experiments was found to be $-123°$ C. By dint of certain modifications effected in the apparatus I am in hopes of achieving a still lower temperature.

Altogether, I have proved that by quickening the evaporation of the ethylene by means of a current of air or hydrogen cooled to a low degree, its temperature is lowered much under that of the critical point of oxygen, and that in such a medium the oxygen liquefies most easilyr[1]

This experiment is so easy of accomplishment, that the practice of it may be commenced at once in laboratories, and be repeated in public lectures.

The apparatus I have described has been constructed with great care by M. Ducretet, and I have to thank M. Jamin for kindly permitting me to perform the expeiiments in the Physical Laboratory of the Sorbonne.

[1] M. E. Sainte-Claire Deville, engineer to the Gas Company of Paris, and son of my illustrious master, has now for some time, by my advice, been studying the problem of lowering the temperature by means of the rapid evaporation of chloride of methylene, and has established that, by sufficiently cooling the injected air, temperatures varying from $-23°$ C., to $-72°$ C. may be maintained nearly constant for several hours.

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

V. *On an "Index-Collection" for small Zoological Museums in the Form of a Genealogical Tree of the Animal Kingdom*

EVEN in the smallest museums it is for many reasons difficult, and often impossible, to arrange the representatives of the various groups of animals in such a way as to bring out clearly their mutual relations. Hence arises the need of an "index-collection" in which each group is represented by one or more specimens so arranged as to indicate as accurately and clearly as possible the affinities of the groups they typify. The form which naturally suggests itself as the most suitable for a small type-collection of the kind indicated is that of a solid phylogenetic diagram or "genealogical tree."

An excellent form of "diagram in three dimensions" for lecture purposes has been devised by Haddon; the model I have recently had constructed appears to me to be more suitable for permanent use in a museum.[1]

It consists of a vertical wooden rod about 3 feet 6 inches in height, representing the main line of descent from Protozoa to Vertebrata; from this spring, at various levels, branches representing types which lie off the direct line; these have in most cases an upward direction, but are directed downwards from their point of origin in the case of degenerate groups. At appropriate points on this framework are placed either actual specimens or models of one or more examples of each group.

As the Vertebrata inevitably take up the largest share of space in a museum as well as of public attention, each of the classes of that group is represented on the model, while in the case of Invertebrata one or two examples only are given to each type or sub-kingdom.

For each group—type or class, as the case may be—a label is provided, giving (*a*) the name of the group, (*b*) the name of the specimen or model serving as an example of it, and (*c*) the place in the Museum where representatives of the group are to be found.

A more correct mode of construction for a model of this kind would be to make the branches of such a length as to bring the ends of all of them, and consequently the specimens they support, to one level; advance of organisation would thus be indicated, not by height above the ground, but by distance from a centre. But such a model would be far less convenient than the form I have adopted.

VI. *On the Size and the External Sexual Characters of the New Zealand Octopus* (*O. maorum*, Hutton)

In his work on the octopus,[2] as well as in his more recent pamphlet, "Sea-Monsters Unmasked,"[3] Mr. Henry Lee states that the largest British specimen he had examined had arms 2½ feet long; that examples with arms of about 4½ feet had been found in the Mediterranean; but that the largest specimens known were those found on the coast of North America (Vancouver's Island), one of which had been measured by Mr. J. K. Lord, who found the length of one arm to be 5 feet.

From this it would seem not to be generally known, even by naturalists, that a species of octopus is very common on some parts of the coast of New Zealand, and notably in Dunedin Harbour, the average size of which is fully equal to, while it occasionally exceeds, that of the specimen from Vancouver's Island just referred to.

I have recently had mounted for this Museum a female *Octopus maorum*, the longest arm of which is 4 feet 3¼ inches, but larger specimens have been frequently seen by my assistants and myself. The following are the dimensions of the largest individual—a male—which we have actually measured:—

		Feet	Inches
Length of body and head		1	1
Diameter of body		0	8
Length of arms—			
1st pair	Left	5	5
	Right	5	3
2nd ,,	Left	4	10
	Right	5	2
3rd pair	Left	4	7
	Right (hectocotylised)	2	11
4th ,,	Left	4	3
	Right	4	8
Diameter of largest suckers (on 1st or "dorsal" arms)		0	1¾

Besides the hectocotylisation of the third right arm, there is a striking difference between the two series which I have not seen mentioned. In the male the suckers simply undergo a gradual diminution in size in passing from the prominal to the distal end of the arm; they retain their characteristic form, and are easily counted up to about half an inch of the tip. In the female, on the other hand, the suckers become quite indistinct for several inches, and in some cases for fully a foot, from the extremity of the arm, taking on the form of small tubercle-like elevations. As an instance of this difference I may mention that in a male specimen with the first left arm 4 feet 2½ inches in length, from 292 to 319 suckers could be readily counted on each arm; while in a female with the corresponding arm of the same length, only 90 to 115 could be counted on each arm, the distal portions bearing tubercles so crowded as to make it practically impossible to count them.

T. JEFFERY PARKER

Dunedin, N.Z., June 19

[1] The model referred to was exhibited and described in detail at a meeting of the Otago Institute on June 9.

[2] "The Octopus; or, the 'Devil-Fish' of Fiction and of Fact." (Chapman and Hall, 1875.)

[3] One of the "Handbooks" of the Fisheries Exhibition, 1883.

THE BRITISH ASSOCIATION

SECTION H—ANTHROPOLOGY

Prof. W. Turner read a paper on *The Index of the Pelvic Brim as a Basis of Classification.*—That the inlet to the human pelvis presented variations in outline and in the proportions of its conjugate and transverse diameters has been recognised since the publication by Vrolik in 1826, and by M. T. Weber in 1830, of their important memoirs on the pelvis in certain races of men. In 1866 Zaaijer, of Leyden, in his study of the pelvis in women of Java, recognised differences in form in women of the same race, and he expressed these differences numerically, taking the transverse diameter as – 100, and then multiplying the conjugate diameter by 100, and dividing by the transverse; the numeral so obtained is the index of the pelvic brim, or "pelvic index." By applying this method to the pelvis in different races of man, a classification of races based on the index of the brim may be framed. In carrying out this method the male pelvis should especially be studied, as in women the pelvis, for sexual reasons, does not present such wide divergences in the form of its inlet as in men. To give precision to the classification, it will be advisable to employ special terms, and in order as far as possible to bring these terms into accordance with those employed in the classification of crania based on differences in the relations of the length to the breadth of the skull, Greek terms will be employed. Thus dolichopellic will signify a pelvis the conjugate diameter of which is longer than the transverse, or closely approaching to it; platypellic, a pelvis in which the transverse diameter greatly exceeds the conjugate; and mesatipellic, a pelvis in which the transverse diameter is not so greatly in excess of the conjugate. Owing to the comparatively limited number of pelves in the different races of men which have been measured, either it may not be possible to fix definitely at present the numerical limits of each of these groups; but the following were adopted provisionally by the author:—dolichopellic, a pelvis with brim index above 9·5; platypellic, one with brim index below 9·0; and mesatipellic, a pelvis with a brim index between 9·0 and 9·5, both inclusive. The number of pelvic measurements from which the author drew his conclusions were comparatively few, but from these it would seem that the dolichopellic division contains Australians, Bushmen, Hottentots, Kaffirs, and Andamanese; whilst Negroes, Tasmanians, and New Caledonians are mesatipellic, and Europeans, Chinese, and probably American Indians belong to the platypellic group. When a pelvis has dolichopellic characters it approximates in the relations of its transverse and conjugate diameters to the form of the pelvic brim met with in mammals lower than man; and in the dolichopellic Australians, Bushmen, Kaffirs, and Andamanese, the length of the sacrum is on the average greater than the breadth, and this also is an animal character.

Mr. W. F. Stanley exhibited a portable scale of proportions of the human body. The instrument is a small thin scale or rule of ivory, about three inches in length, and divided on each edge of the two faces by lines which represent the proportions of the human body, the male on the one side, and the female on the other. The opposite edge to that on which the proportions are shown is divided into 100 parts in the same space as the height of the body. The object aimed at by the use of this scale is to compare any person, or statue, or photograph with the model of perfect human form given by John Marshall, or to determine the parts of the body in proportional decimals of the whole, to facilitate description.

Mr. J. Theodore Bent read a paper on *Insular Greek Customs* as seen in the islands of the Ægean Sea. He proceeded to notice the modern Greek customs concerning birth and childhood, comparing them with ancient ones, among the customs described being that of fate-telling, and the notions regarding the deleterious influence of Nereids on children. The customs connected with death and burials were next described, and shown to be the same as those of the Greeks 2000 years ago. Some instances were given of the poetry of death-wails, and it was shown that the belief in Charon and Hades existed still in the islands of the Ægean Sea. Among the other customs described in the paper were feasts for the dead, which could be traced to a remote antiquity, and the ancient belief in vampires still survived. Instances were also given from agricultural life of the identity between ancient and modern customs, including the ceremony gone through before sowing of seed, the use of skins for grain, the granaries in the ground, in the kind of agricultural implements used, and also in the names used for animals.

Gen. Pitt-Rivers explained the provisions of the Act of Parliament relating to the preservation of ancient monuments. The Act scheduled the most important and best-known ancient monuments in the country, and provided that these should be registered. and after their registration, although they remained the property of the owner of the land on which they were situated, and might be sold along with the land, could not be destroyed by the owners. There were also a vast number of minor monuments of great interest and value well worthy of being preserved. It was not proposed that the Government should meddle with these minor monuments. What he (Gen. Pitt-Rivers) had done with regard to these minor monuments was to endeavour to see all the principal gentlemen most interested in local archæology, and ask them to let him know when any injury was done to monuments in their district. In the Island of Lewis the agent of Lady Matheson had promised to assist him in every way he possibly could; and Dr. Aitken, Inverness, had promised to him to do the same thing; and he had received promises of a like kind from a number of other gentlemen. In his wanderings throughout the country in connection with the working of this Act of Parliament, he had found no owner of the monuments scheduled in the Act unwilling to put his monument under the Act because he wished to destroy it. The feeling of those who were unwilling to put their monuments under the Act had rather been that they considered they were quite as able and willing as the Government to preserve the monuments. What the State desired was to preserve the monuments in the hands of any owners into whose hands they might fall. In these days there was no knowing to whom land might belong now that the gospel of plunder was proclaimed, and it was desirable that there should be some sort of security that the monuments might be preserved hereafter. As the result of his wanderings in order to work this Act in England and Wales, about half of the owners of the scheduled monuments had voluntarily placed them under the protection of the Act. In certain cases the monuments were leased, and the proprietors refused to place them under the Act without compensation, which the Government could not give.

Miss A. W. Buckland read a paper on *American Shell-Work and its Affinities*. In this paper the attention of anthropologists was called to some remarkable works in shell recently discovered in mounds in various States of North America, as described by Mr. W. H. Holmes in a valuable contribution to the *Proceedings* of the Bureau of Ethnology, Washington. These shell-works consist not only of beads of various shapes and sizes, but also of celts, fish-hooks, chips, and other implements of war and the chase, bracelets, pins, crosses of various forms, and more particularly of masks and elaborately engraved gorgets, the ornamentation upon which seems to bear some religious or astronomical signification. From the fact that implements and ornaments of the same form are found in the islands of the Pacific, and that some of the peculiar symbols engraved upon the ancient American gorgets reappear slightly altered on shell gorgets in the Solomon and Admiralty Islands, and also on the great Japanese drum exhibited this year at the Inventions Exhibition, the author inferred that a commerce existed between the islands of the Pacific and the American continent prior to the Spanish conquest.

Mr. E. F. im Thurn read a paper giving an account of the red men about Roraima, in British Guiana. In the paper an interesting account was given of the journey to Roraima, the scenery being described, as well as the manners and customs of the natives. In some of the villages visited the natives had never previously seen white men, and the utmost excitement was caused by the arrival of Mr. im Thurn. The natives of the villages visited were repulsively ugly, and it was almost impossible to distinguish men from women by their dress. The native tribes lived in remarkable isolation from each other, and even the different families in the same village lived in remarkable isolation from each other. There were traces of the Stone Age to be found of high interest. Stones were shaped into adzes and wedges, and they were often made into forms of animals, or of whistles, and models of bottles, which the natives had seen. There was among these tribes a revival of the ancient art of making stone implements, though these implements were simply regarded as ornaments. The natives also made drawings of rocks, which were used as ornaments, and which were evidently imitations of the drawings seen on the actual rocks. Mr. im Thurn closed his paper with an account of a number of some very remarkable games played by the tribes for the amusement of the visitors, in which the movements of animals were imitated in dances.

Mr. J. W. Crombie read a paper entitled *A Game with a History*, which was really an exposition of the antiquity, universality, and signification of the well-known game of "Hop-Scotch," a term which is probably a corruption of "hop-score." The author commenced by pointing out that as children in their play generally imitate something they have observed to be done by their elders, and a game once introduced is handed down from generation to generation of children long after its original has ceased to exist, many innocent-looking children's games conceal strange records of past ages and pagan times; hence the importance of the study of this apparently frivolous subject is now fully recognised by anthropologists. The game of "Hop-Scotch" is one of great antiquity, having been known in England for more than two centuries, and it is played all over Europe under different names. Signor Pitrè's solar explanation of its origin appears improbable, for, not only is the evidence in its favour extremely weak, but it would require the original number of divisions in the figure to have been twelve instead of seven, which is the number indicated by a considerable body of evidence. It would seem more probable that the game at one time represented the progress of the soul from earth to heaven through various intermediate states, the name given to the last court being most frequently Paradise or an equivalent, such as Crown or Glory, while the names of the other courts correspond with the eschatological ideas prevalent in the early days of Christianity. Some such game existed prior to Christianity, and the author considers that it has been derived from several ancient games; possibly the strange myths of the labyrinths may have had something to do with "Hop-Scotch," and a variety of the game played in England under the name of "Round Hop-Scotch" is almost identical with a game described by Pliny as being played by the boys of his day. The author believes that the early Christians adopted the general idea of the ancient game, but they not only converted it into an allegory of heaven, with Christian beliefs and Christian names, they Christianised the figure also; abandoning the heathen labyrinth, they replaced it by the form of the Basilicon, the early Christian church, dividing it into seven parts, as they believed heaven to be divided, and placing Paradise, the inner sanctum of heaven, in the position of the altar, the inner sanctum of their earthly church.

Mr. George Campbell, M.P., read a paper entitled *The Rule of the Road from an Anthropological Point of View*, in which he maintained that for all right-handed people the rule of going to the left hand in passing people was the most scientific and the most convenient. There was nothing, he maintained, to be said in favour of going to the right, and he held that the British rule should be maintained both for roads and for footpaths, and that we should give in to no right-handed innovation.

Miss Jeanie M. Laing read a paper on *The Modes of Grinding and Drying Corn in Old Times*. In some parts of Aberdeenshire are found the remains of the straw kilns that were used for drying corn before sending it to the mill. The kiln was conical in shape, joists called cabers were laid across, some distance from the ground, and above these were roughly-hewn saplings called simmers; on the top of these was spread straw, and on the straw was laid the corn. A fire was kindled on the ground, and the heat therefrom dried the corn. A stone called a sparker was placed above the fire to catch the sparks, but in spite of this precaution the kiln sometimes took fire. At an early period corn was ground between two millstones, with an iron rod by way of a handle; this primitive mill was called a quern, and was generally turned by two women, as in Eastern lands. In later times querns were used for grinding malt.

Mr. A. J. Evans contributed a paper on *The Flint-Knappers' Art in Albania*, and exhibited some beautifully-worked gun-flints and strike-a-lights, partially cased in ornamented lead sheaths studded with glass gems.

Mr. W. M. Flinders Petrie read a paper on *The Discovery of Naukratis*, the remains of which city had been brought to light during the work of the Egypt Evploration Fund in the first half of this year.

Mr. Thomas Wilson read a paper on *A New Man of Mentone*, in which he described the discovery, in March, 1884, in one of the famous caverns at Mentone, of a skeleton, believed to belong to the Palæolithic age. The excavations were made during the winter of 1883–4 by M. Louis Julien, of Marseilles, and at his expense, aided by the advice of M. Bonfils, Curator of the Museum at Mentone. This cavern had been searched many times before, and about 9 or 10 feet in depth had been removed from the original surface, which, however, was plainly marked by a large piece of *brèche* which still adhered to the perpendicular side wall. The formation of the floor of the cavern and the process of its filling up presented all the usual evidences of human occupation and industry: charcoal, burnt earth and ashes, hearthstones, split and broken bones of animals (estimated to the number of 15,000 pieces), flint instruments, chips, nuclei, &c., &c., were found in sufficient number, quantity, and distribution to indicate an indefinitely long occupation. No morsel of pottery was found, nor were any of the stone implements polished. At the depth (from the original surface) of 8 metres 40 centimetres was found the skeleton of this "new man of Mentone." He was laid on his back with his limbs extended, and had for funeral equipments three large chips of flint (*éclats de silex*), 6 or 7 inches long and 2½ inches broad, in the form of the largest scrapers, placed one on each shoulder like epaulettes, and one on the brow. It was evidently an interment. This became more evident when it was found that the body was placed in a sort of natural vault or tomb, formed on one side by the wall of the cavern, and on the other by an immense block of stone with an overhanging edge, which reached to a line perpendicularly over the centre of the skeleton. This placing of the body required an excavation between these rocks of 3 or 4 feet in depth. The skull was broken into sixty fragments by the pick of the workman; it was carefully taken up and put together by M. Bonfils, and is now exposed in the Museum at Mentone. This was a fortunate accident, for while the rest of the skeleton was being exhumed a quarrel broke out as to ownership, which ended in the theft and utter destruction of all that remained. Mr. Wilson maintained that the new discovery of the skeleton dissipated all idea of disturbance, for while disturbance might exist for one or two, or even five or six feet, to the depth of twenty or thirty feet it would be impossible. It must be conceded that the human industry as manifested by the objects found in these caverns, indicated their occupation during the palæolithic age, for of the thousands found, all bear the impress of that age, while none denote particularly the age of polished stone. Mr. Pengelly said that he had visited the cavern where M. Rivière's new man of Mentone was found, and he was of opinion that the man found by M. Rivière had not been interred at all, but had died where the body was found, and had been buried by the sand blown into the cavern, and the waste of the walls of the cavern. He had measured the place himself where the body was found, and found that it was only eight feet below the surface. The skull of the man was so good that he should have been glad to have possessed such a skull. It was a large skull, and the measurements he made of the bone showed that the man must have been of great stature. The bones of animals found in the cavern were partly those of animals now extinct, and partly those of existing species. With reference to the age in which the man found by Rivière lived, his impression was that it was the palæolithic age. He would not say so positively, however, and from the information they possessed he did not think that the man would be of any value whatever for or against the doctrine of human antiquity.

Dr. R. Munro read a paper on *The Archæological Importance of Ancient British Lake-Dwellings and their Relation to Analogous Remains in Europe*. Dr. Munro commenced by giving a short introductory notice of the discovery and investigation of the crannogs of Ireland and the lake-dwellings of Central Europe. He then gave a *résumé* of the more recent explorations made among the crannogs of Scotland and the remarkable objects recovered from them. From a comparative examination of these relics with other collateral antiquities of the Celts, he arrived at the conclusion that the lake-dwellings of Scotland were essentially the product of Celtic genius, that they were constructed for defensive purposes, and that those in the south-west parts of the country attained their greatest development in post-Roman times, after Roman protection was withdrawn from the provincial inhabitants, and they were left single-handed to contend against the Angles on the east and the Picts and Scots on the north. Having established the Celtic origin of the crannogs of Ireland and Scotland, Dr. Munro proceeded to inquire if there is any ancestral relationship between them and the lake-dwellings of Central Europe. Taking into account the recent discovery of lacustrine abodes in the Holderness and the few previous records of their existence in Wales and other parts of England, together with the statement of Cæsar that the Britons were in the habit of making use of wooden piles and marshes in their defensive works, he thought that such indications are not merely solitary instances, but the outliers of a widely distributed custom which prevailed in the southern parts of Britain at an earlier date than that assigned to the crannogs of Scotland. Hence he suggested the theory that the British Celts were an offshoot of the founders of the Swiss lake-dwellings, who emigrated into Britain when these lacustrine abodes were in full vogue, and so retained a knowledge of the custom long after it had fallen into desuetude in Europe. On this hypothesis it would follow that subsequent immigrants into Britain, such as the Belgæ, Angles, &c., being no longer acquainted with the subject, would cultivate new and perhaps improved methods of defensive warfare; whilst the first Celtic invaders, still retaining their primary notions of civilisation, when obliged to act on the defensive would naturally have recourse to their inherited system of protection. In support of this hypothesis the author pointed out that the geographical distribution of lake-dwellings, so far as they are known in Europe, closely corresponds with the area formerly occupied by the Celts; that no lake-dwellings have been yet found either in the northern or southern parts of Europe, though the topographical and hydrographical conditions of these regions are not unfavourable for such structures; that the *fascine* dwellings in Europe were identical in structure with the crannogs; and that, though the pile-dwellings were not largely used in the British Isles, the principles on which they were built were not unknown, their disuse being due to topographical and other considerations. Finally, he argued that the wideness in the chronological gap which is supposed to separate the crannogs from the lake-dwellings of Europe is more apparent than real, as the latter existed during the Roman occupation of Gaul, and in one instance at least the custom survived to about the tenth century.

Prof. D. J. Cunningham exhibited a large coloured plate of sections of a young chimpanzee, illustrative of some important points of comparison between the chimpanzee and man. Prof. Cunningham said that he had purchased a male chimpanzee, which was said to have died in the process of second dentition, and which he believed to be about six years of age. The body of the chimpanzee was frozen for two days, and he now exhibited the sections of the chimpanzee for the purpose of showing one or two points of comparison between the chimpanzee and man. Any one looking at the plate would be attracted to the region of the face, where the protrusion was shown which was so well seen in the living animal. If they compared it with the corresponding section of man they would find brought out very forcibly the elongated brute-like tongue of the chimpanzee. An anatomist looking at the section now exhibited would fix his attention at once upon the spine. In man the spinal form was beautifully curved. It showed an alternation of curves in the different regions of the body, and to these curves in the spine of man in a great measure was due in his erect attitude. It was remarkable that the chimpanzee even at six years of age there was a very manifest lumbar curve. In the Biological Section that day there had been described the spine of a child six years of age, and it was remarkable that the lumbar curve in this chimpanzee of a corresponding age was very much more marked than in the child. At six years the chimpanzee was much more advanced in life than a child six years old, and therefore his lumbar curve was correspondingly greater. If they wished to get at the distinction between the spine of man and the chimpanzee they must look lower down at the sacrum. After noticing one or two other points, Dr. Cunningham drew the conclusion that the human child occupied an intermediate position between the chimpanzee and the human adult. In the plate he now exhibited they would see compared the skull of the chimpanzee with that of man, bringing out that the cerebral or larger brain in man extended a good deal further back than in the chimpanzee; and there was not much difference between the New World ape and the chimpanzee in that respect.

Dr. J. G. Garson, one of the secretaries of the Section, read a paper on *Abnormal and Arrested Development as an Induction of Evolutionary History*. Dr. Garson began by stating that, perhaps, the most fertile source of information regarding the history of man's evolution was derived from a study of his embryological development. Another source from which much valuable information regarding the early history of our own specialisation, and that of other animals, might be gleaned, was Teratology, which had for its domain the consideration of abnormal conditions of development. Many of the conditions included under this branch were of a pathological nature, and due to the effects of disease; others, however, were not—such, for example, as an abnormal and an unusual production of normal structures and cases of arrested development. It was to a consideration of some conditions occurring under one or other of these categories that he ventured now to call attention. The examples which he had selected had come more especially under his own observation. Persons were occasionally found with abnormal development of hair on their bodies. The type of mammal was an animal whose body was covered with hair. Under certain circumstances the hair might more or less disappear, according to the conditions under which the animal lived. In man it was only feebly developed, except on the head; and in the cetacea or whales it had entirely disappeared, with the exception of a very few bristles near the mouth. Dr. Garson proceeded to explain how excessive development of hair takes place in man. In ordinary cases the hair-growing apparatus in the embryo remained stationary, instead of keeping pace with the growth and development of the other organs of the body, with the result that no hairy covering such as was found in other mammals was present, but only short rudimentary hairs appeared at intervals. But in some exceptional cases this stationary condition of the hair follicles did not occur, and they went on actively developing with the rest of the body, with the result that a hairy covering was produced over the body. The hairless condition now normal in man had evidently been gradually acquired through a long period of time, as such a change could not take place rapidly and become such a stable condition as it was found to be otherwise. Abnormal development of fingers occurred sometimes in man, but must be classed entirely apart from such forms of abnormality as had been considered in the hair-growth. In arrested development the abnormal organ or portion of the body, instead of going through the various stages it usually does till it arrives at the condition it normally assumed in the group of animals in which it occurs, stops short at one or other stages. The stage at which it stops may correspond to that which is normal in a lower grade of animal life, and so gives direct evidence that the higher forms of animal life, such as man, pass through and beyond the stages at which the lower stop. It must not be forgotten also that in some respects an animal of a lower grade may possess specialisations in some structures or organs of a higher ground than animals much higher in the scale of life.

Dr. Robert Laws, from Livingstonia, Lake Nyassa, East Central Africa, read a long and interesting paper descriptive of the manners and customs of the Bantu tribes living around Lake Nyassa in Eastern Central Africa. In the outset of his paper Dr. Laws said that Lake Nyassa was 350 miles long, and varied from 16 to 60 miles broad, and around that vast inland sea they knew of fifteen different tribes, speaking so many different languages, besides dialects of these languages. Though these tribes had much in common, they differed among themselves in many of their habits, customs, and religious beliefs. He proceeded to notice the names and residences of the leading tribes, and gave a brief summary of what was known of their history. As a rule, he said, the people of all these tribes were physically developed, but their vigour and general healthy condition differed considerably, depending chiefly on the climate, soil, and food. Where maize and mapira were the staple foods, the natives were strong and hardy. Where cassava root was their chief food, and especially if along with that there was a state of actual or dreaded warfare, the people were weak and sickly. On the hills the people were hardier and more vigorous than on the lake-shores and on the river-banks. Mental energy was greater on the hills than at the lake-side, and at places where there was most radiated heat this was less than where the breezes played freely. Keenness of vision and acuteness of hearing were spoken of as being remarkable in civilised tribes, and among the lake tribes these faculties attracted the attention of travellers, but Dr. Laws was inclined to attribute these characteristics to training and exercise in given directions rather than to any radical superiority in the organs of sight and hearing among the tribes. All the tribes depended principally on agriculture for their support, and the only appearance of a rudimental division of labour was to be found in the classes of fishermen and blacksmiths. No traces of a Stone age had been found among these tribes. Yet in certain districts they were to be found cultivating their gardens with tools of hard wood instead of iron, distance from markets being the cause of their use. At the east side of Nyassa many lake-dwellings were found in 1875, and often on war being threatened the inhabitants of the lake shore took refuge by living in such constructions. Iron mines had been found, and copper had been found in one of those near the Livingstone range. The iron of the mines was usually near the surface. Charcoal was used for smelting. Dr. Laws went on to describe the manner in which the tribes made their canoes, their nets, and their huts. Fire was procured among them by the rapid rotation of rods of wood between the hands, the spark being caught in cloth and kindled into a flame. The natives exhibited great surprise when they saw the traveller strike a lucifer match, and that was regarded by them as an unquestionable proof of his superior knowledge. The natives indicated time by pointing to the position of the sun. They named Sunday as the day of God, Monday as the day for beginning work, Saturday as the day for stopping work. The intermediate days were indicated by numbers. The eclipse of the moon was described as the moon put in a bag, and comets as stars with tails. Slavery was common in all the tribes, and half of its horrors had not been told. Infanticide was not practised, but infant mortality was very high, and cases had been found of children labouring under a lingering disease having been buried alive. Polygamy was common, and the number of a man's wives taken as an index of his wealth. One chief told him he had a hundred wives, and he (Dr. Laws) believed he was rather under-estimating than over-estimating the number. The early marriage of girls was the rule, and in one tribe a girl was often betrothed before she was born. In buying land they had to buy it first from the chief and then buy the tenant-right from the cultivators. After describing the customs of the tribes relating to the punishment of crime, Dr. Laws concluded his paper by noting the leading peculiarities of the language of the tribes, directing especial attention to the complications in the forms of speech, and especially to the extraordinary number of variations in the verbs.

Mr. E. H. Man contributed a paper on *The Nicobar Islanders*.—In the interior of Great Nicobar there is a wild race, styling themselves "Shab Dawá," of whom as yet little information has been obtainable; they are distinct from the inhabitants of the other islands and of the villages on their own seaboard, who are of Malay origin, and by whom they are called "Shom Peñ" ("Shom" denoting tribe," and "Peñ" being the tribal designation). It appears certain that they are the descendants of a very ancient aboriginal population of Mongolian origin. The first mention that we find of them is from the pen of pastor Rosen, a Danish missionary, who, while resident at the Nicobar Islands between the years 1831–34, spoke of them, from hearsay, as in much the same degraded condition as we find them at the present day. He said that "they wear no clothes, possess no houses, live like animals in the depths of the forest, and shun the sight of men, never leaving their lairs except to search for food, which they sometimes steal from such of the coast huts as are temporarily vacated or occupied only by a few aged or infirm folk whom they are able to surprise or overpower." In 1876 and 1881 a few members of this tribe living near the north-east of Great Nicobar were seen by the late Mr. de Röepstorff, who was accompanied in the latter year by Col. T. Cadell, V.C., Chief Commissioner of the Andamans and Nicobars. During the last eighteen months Mr. E. H. Man, while in charge of the Nicobar Islands, has paid six visits to Great Nicobar, on four of which he succeeded in seeing and photograhing parties of this tribe, both near Ganges Harbour and on the west coast. On the first of these occasions (viz. February 1884) two youths, aged about eighteen and fourteen years respectively, were persuaded to leave their friends for seven days, at the end of which they were conveyed back from Nancowry in the settlement steamer. During their visit to Mr. Man they proved themselves tractable and timid, and submitted with a good grace to ablutions which were found very necessary. Although this is the first recorded instance of a Peñ having ventured from his savage haunts, these lads exhibited the Oriental characteristic absence of wonderment at all the novel surroundings and tokens of civilisation in the Government settlement. They were fair specimens of their race, the members of which are found to be usually well nourished, of good physique, and, while young, favoured with pleasant features. The height of the males appears to range between 5 feet 2 inches and 5 feet 8 inches; their skin is fairer than that of the generality of the coast people, who, on their part, are less dark than the Malay; the hands and feet seem to be decidedly large, and bear evidence of the rough work of their daily lives; the hair, which is straight, is commonly worn uncut and unkempt, and, as habits of cleanliness are manifestly foreign to their nature, its condition can better be imagined than described. As a result of their friendly intercourse in recent years with the coast people, they have acquired the habit, so universally practised among the latter, of chewing the betel-nut (*Chavica betle*) with or without quicklime, and are consequently beginning to be similarly disfigured with black teeth, though not yet to the hideous extent common among their more civilised, or, rather, less savage, neighbours. They likewise now imitate the latter in respect to clothing, the men adopting the narrow loin-cloth and the women a small cloth skirt. Their dwellings are small, and cannot compare with those of the coast people, and are indeed but little, if at all, superior to those of the Negritos in Little Andaman, but they more nearly assimilate the former in design as well as mode of construction, for they are erected on posts; the floors being raised 6 or 7 feet above the ground necessitate the use of ladders. It is impossible, within the limits of this abstract, to make further mention of the dwellings, or to describe the peculiar sack-like cooking-vessels of this strange race. Mr. Man hopes before long to be able to supplement in many particulars the rudimentary information which has hitherto been obtainable regarding the Peñ, but the task is one of considerable difficulty, for, apart from the dread entertained by this tribe towards aliens, their frequent feuds place from time to time a temporary barrier to all intercourse between them and our friends on the coast, through whom at present all our communications have to be conducted. The nearest portion of Great Nicobar Island is, moreover, about 60 miles distant from the Government settlement at Nancowry.

SCIENCE IN RUSSIA

THE Kazan Society of Naturalists continued last year its valuable explorations of Eastern Russia, and we have before us several new fascicules of its *Memoirs* and *Proceedings*.[1] M. Ivanitsky publishes a list of plants of the Government of Vologda, which contains 804 Spermatophytæ, Gymnospermæ, and Sporophytæ. As to these last, only 6 Equisetaceæ, 5 Licopodiaceæ, and 20 ferns being given, the list obviously will be much extended by subsequent research. The flora of Vologda, which is situated on the limits of the middle and Arctic Russian floras, offers a certain special interest, and M. Ivanitsky has not neglected to mention the wild and cultivated plants which find their northern limits within the province. It consists chiefly of Compositeæ (107 species), 49 Cyperaceæ, 48 Gramineæ, 41 to 34 each of Ranunculaceæ, Caryophylleæ, Rosaceæ, and Cruciæeræ, 27 to 22 Papilionaceæ, Scrophulariæ, Labiatæ, Salicineæ, and Polygonaceæ, and 21 to 19 Umbelliferæ, Filices, and Orchideæ. The list of plants is prefaced by a masterly sketch of the physical conditions of separate parts of the province. The same volume contains a paper by M Mislavsky on the irritability of the nervous-muscular system, being an inquiry into the causes of the well-known differences of the effects of electrical irritation on the frog, when measured by the methods of Dubois-Reymond. All causes which may depend upon the conditions of the experiments themselves having been eliminated, there still remain notable differences which must be ascribed to the state of the system altogether. A paper, by Th. Tsomakion, on the laws of transmission of electricity through gases, embodies the results of several new experiments in this field. In a former inquiry the author, by introducing into the chain of condensation a discharger where the discharge could take place only at close contact of the two electrodes, had experimentally proved the law, already deduced by Forselman and Heer, that the whole amount of heat produced at the discharge of the condensator does not depend upon the composition of the chain. But as soon as he introduced a layer of gas between the electrodes, he found that his results widely differed from all previously obtained by other students; he undertook a series of experiments for discovering the sources of that discrepancy of results, and he has arrived at a long series of conclusions which are of great interest, but ought to be submitted to a closer inquiry. This last is continued.—To the same vol. xiii. M. Zaitseff contributes a paper on the petrography of the crystalline rocks in the neighbourhood of Krasnovodsk, on the eastern shore of the Caspian. The chief rock in the Shakh-Adam Mountains, which reach about 600 feet above the sea, is a massive, unstratified quartz-dioritic porphyrite (according to the classification of Herr Rosenbusch). Between the bays of Muravioff and Soymonoff the rocks are closely akin to the above, and might be described as a quartz-mica-diorite. The former extends also for some miles east of Krasnovodsk, and is intersected by veins of a muscovite-granite (according to Herr Rosenbusch's classification) and quartz porphyry of rare occurrence, its magnesial mica being replaced by a potassium mica.—The same author contributes two papers on the petrography of the Soymonoff valley in the south-east part of the district of Ekaterinburg, which incloses the 3200 feet high Yurma summit and several high ridges of mountains. The author makes a detailed inquiry into the structure of the crystalline rocks of this locality (granites, gneisses, and various schists), and is inclined to admit that at least one part of the olivine-bearing serpentines endow their origin to the metamorphism of the actinolite schists. The iron ores and gold-bearing deposits are also described, the age of these last being undoubtedly settled as Post-Pliocene, as they contain numerous remains of Mammoth, *Bos primigenius*, *Cervus tarandus*, and *Cervus alces*. We may remark that the very high position of several gold-bearing deposits on the slopes of the valleys and their structure is one testimony more in favour of their glacial origin, but the author does not touch this interesting question. He mentions also—a fact which has often been doubted, but is now confirmed more and more—that the gold of these deposits is derived from the decomposition of the chloritic slates. The papers are accompanied by a geological map. In the same volume (fasc. 4) we find a preliminary report, by S. Korzinsky, on a botanical excursion into the delta of the Volga. The list of plants is not yet given by the author, and he publishes only a valuable sketch of the general characters of the delta, distinguishing in it two different regions: the delta proper, which consists of fluviatile deposits; and the Steppe region, covered with the so-called *bougry*, or a kind of *kames*, first described by Karl Bear and still bearing his name, about which *bougry* the author holds a different opinion as to their origin, denying—with full right, we suppose—their origin from the retreat of the Caspian.

As to the *Proceedings* of the Kazan Society, we are glad to learn from them that three new meteorological stations (at Sarapul, Tcherdyn, and Debessy) have been added to those already organised by the Society. There was a great want of meteorological observations precisely for that part of North-East Russia. Several shorter papers are embodied in the *Proceedings*:—On the geology of the Vetluga region, by P. Krotoff (a polemic concerning the Permian and Trias, as also the southern limit of the boulders).—On the fauna of Kazan (between the Kama and Vyatka), by N. Varpakhovsky. The author gives the lists of fishes found in the lakes and rivers, and lists also of serpents and amphibians of the region.—On the preparation

[1] *Trudy Obschestua Estestvoispytatelei pri Kazanskom Universitete*, vol. xii. fasc. 5 and 6; vol. xiii. fasc. 1 to 4.—*Protokoly* (*Proceedings*) of the same for the years 1883 and 1884.

of tripsine, by V. Nikolsky.—On the *bougry* of the Caspian, by A. Zaitseff. They do *not* have the uniformity of structure supposed by Baer; they often cross one another at angles of 20° to 30°, and some of them follow a north-eastern direction, while others, close by, run west and east; and they contain not only broken mussels, as affirmed by Baer, but also plenty of quite full mussels of *Cardium trigonoides*, *Dreissena polymorpha*, *rostriformis*, and *caspia*. The theory of Baer altogether is based on an insufficient supply of data, and the structure of the *bougry* ought to be better explored before pronouncing as to their origin.—On the sulphur ores at Tetushi, on the Volga, by G. Wilenius.

The fourth volume of the "Collection of Materials for the Description of Caucasus,"[1] published by the schoolmasters of Caucasus, contains, as usual, much valuable information, especially of historical and ethnographical character. M. Hahn contributes a most valuable paper of 250 pages, in which he has compiled all information on the Caucasus he was able to discover in authors since Homer up to the fifth century of our era. The information gathered from Byzantine writers who have much more written about the Caucasus, will be embodied in a second part of the work. The importance of this very careful work, where textual translations are given of passages dealing with the Caucasus and its inhabitants from no less than eighty Greek and Latin authors, will be fully appreciated by all those who have to deal with the geography of the country. A complete index will much facilitate the research. M. Eivazoff gives a description of the Aisores of Koilasar, of their manner of life and customs, followed by an Aisor alphabet; and M. Arkannikoff contributes a detailed description of the town Temruk and of the Temruk mouth of the Kuban River. In the second part of the same collection we find a series of interesting notes on the Tchokh village in Daghestan, on Daghestan legends, and on the life of Abkhazes; a collection of Little Russian songs from Kuban; and two lectures on the beautiful seven-centuries-old Georgian poem of Shota Rustaveli.

SCIENTIFIC SERIALS

THE *Journal of Physiology* for July contains:—Note on the cause of the first sound of the heart, by G. F. Yeo and J. Barrett.—An experimental investigation to ascertain the action of veratria on a cardiac contraction, by S. Ringer (plate 2).—Concerning the action of small quantities of calcium, sodium, and potassium salts upon the vitality and function of contractile tissue and the cuticular cells of fishes, by S. Ringer and D. W. Burton.—A study of the action of the depressor nerve, and a consideration of the effect of blood-pressure upon the heart regarded as a sensory organ, by H. Sewall and D. W. Steiner (plate 3).—On secondary and tertiary degenerations in the spinal cord of the dog, by C. S. Sherrington (plates 4 and 5).—On the structure and rhythm of the heart in fishes, with especial reference to the heart of the eel, by S. A. M'William (plate 6).—The innervation of the heart of the Slider terrapin (*Pseudemys rugosa*), by J. Wesley Mills.—Note on the sound accompanying the single contraction of skeletal muscle, by E. F. Herroun and G. F. Yeo.

The Journal of Anatomy and Physiology for July contains: Account of some recent experiments on the effects of very low temperatures on the putrefactive process and some vital phenomena, by J. J. Coleman and J. G. McKendrick, M.D.—Accessory lobe to the left lung, by L. Humphry, M.B. (plate 17).—Case of abnormal development of the reproductive organs of the frog, by A. F. S. Kent (plate 18).—Rotation and circumduction, by Thomas Dwight, M.D.—Movements of the ulna in pronation and supination, by C. W. Cathcart, M.B.—Anatomy of a hydro-monocephalous brain, by A. Hill, M.D.—Corpus callosum in the adult human brain, by Dr. J. Hamilton, (plates 21 and 22).—Tumours in animals, by J. B. Sutton (plate 23).—Hyomandibular clefts and pseudobranchs of Lepidosteus and Amia, by R. Ramsay Wright (plate 24).—Anatomy of *Spinal bifida*, by Prof. Humphry.—Notes on some variations of the shoulder muscles, by W. B. Ransom.—Tarsus and Carpus, by Prof. K. Bardeleben.

The Quarterly Journal of Microscopical Science for July contains:—On spermatogenesis in the rat, by Herbert H. Brown (plates 22 and 23).—A simplified view of the histology of the striped muscular fibre, by B. Melland (plate 24).—On the development of a freshwater macrurous crustacean (*Atyephora compressa*), by C. Ishikawa (plates 25–28).—On the supposed communication of the vascular system with the exterior in Pleurobranchus, by A. G. Bourne, D.Sc. (plate 29).—Observations on the nervous system of Apus, by P. Pelseneer (plate 30).—Note on the chemical composition of the zoocytium of *Ophrydium versatile*, by W. D. Halliburton, M.D.—The development of *Peripatus capensis*, by A. Sedgwick, M.A. (plates 31 and 32).

The Journal of the Royal Microscopical Society for August contains:—The pathogenic history and the history under cultivation of a new bacillus (*B. alvi*), the cause of a disease of the hive bee hitherto known as foul brood, by F. R. Cheshire and W. Watson Cheyne, M.D. (plates 10 and 11).—Experiments on feeding some insects with the curved or "comma" bacillus, and also with another bacillus (*B. subtilis?*), by R. L. Maddox, M.D.—On four new species of the genus Floscularia and on five other new species of Rotifera, by C. T. Hudson, LL.D. (plate 12), with the usual summary of current researches.

The American Naturalist for September contains the reputation of the Lantern fly (*Fulgoræ lanternaria*), by John C. Brauner. To the bibliographical references made in an editorial note to this paper may be added the spirited discussion on the whole subject in the *Entomological Magazine* of 1836.—The age of forest trees, by J. T. Campbell.—The relations of mind and matter, by C. Morris.—The exhalation of ozone by odorous plants, by J. M. Anders and G. B. M. Miller.—Glacial origin of Presque Isle, Lake Erie, by J. D. Ingersoll.—Recent literature and general notes.

The Proceedings of the Linnean Society of New South Wales, vol. x. Part 1 (June 4).—The papers in this part are of great interest, and worthily sustain the credit of this most active and energetic Society. *Zoology* — Dr. R. von Lindenfeld, On Australian sponges, part iv. The Myxospongiæ, with 5 plates. On *Amœba parasitica*, a new protozoon infesting sheep. On the Phoriospongiæ.—William Macleay, On a new snake from the Barrow Ranges, and On some reptiles from Herbert River.—A. S. Oliff, On some Ceylonese Coleoptera.—J. Brazier, Synonymy of some shells described by Dr. Gray.—W. A. Hasnell, On some Australian Amphipods, with 9 plates.—Captain Hutton, Revision of the Toxoglossate mollusca of New Zealand.—J. Douglas Ogilby, Some rare Port Jackson fishes. *Botany*—Dr. W. Woois, Australian Proteaceæ. *Palæontology*—F. Rattle, On a Devonian Australian fossil allied to Worthenia, with a plate; also on the Glacial period in Australia; and on the meteorology of Mount Koskiusko, by Dr. von Lindenfeld, with two plates.

Morphologisches Jahrbuch, Band 11, Heft 1, contains:—Contribution to a knowledge of the renal organ of the Prosobranchia, by Dr. B. Haller (plates 1–4).—On the morphological significance of the nucleus, by Dr. W. Pfitzner (plate 5).—Short contributions to a knowledge of some marine Rhizopods, by O. Bütschli (plates 6 and 7).—On the significance of the *Linea semicircularis Douglassii*, by Bernhard Solger.—Notes on Apseudes, by J. E. V. Boas.—Short Notes.

Zeitschrift für wissenschaftliche Zoologie, Band 42, Heft 1, July 24, contains:—A biographical sketch of Carl Theodor Ernst von Siebold, one of the founders of the *Zeitschrift*, by Ehlers (with a photograph).—On the significance of the nucleus from the point of view of evolution, by Prof. A. Kölliker.—Researches on some Flagellates and kindred organisms, by Dr. C. Fisch (plates 1 to 4).—On the anatomy of the Amphisbœna, by Dr. Carl Smalian (plates 5 and 6).

Band 42, Heft 2, August 18, contains:—An essay on the history of German slugs, and on their European allies, by Dr. H. Simroth. This monograph is illustrated by five plates, that of the species being coloured.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 5.—M. Bouley, President, in the chair.—Spectral analysis of the elements of the terrestrial atmosphere, by M. J. Janssen. The author describes the special arrangements that have been made at the Meudon

[1] "Sbornik materialov dla opisania myestnostei i plemen Kavkaza." Tiflis, 1884.

Observatory for the study of the hydrogen, oxygen, and other substances present in the terrestrial atmosphere. Four tubes, one 60 metres long, have already been fitted up in a chamber in which solar, electric and other lights can be employed under favourable conditions.—Thermic studies of the aromatic series: the phenols of complex function, by M. Berthelot. New characters derived from thermo-chemistry have been determined for the purpose of distinguishing the various isomerous groups of the aromatic series and disclosing the phenolic function belonging more particularly to some of these groups. In order to establish the general character and importance of this new instrument of research, the author continues his experiments with the compounds derived from the oxybenzoic acids, to which the synthesis of vanilline and the allied substances has given so much interest. The results already obtained establish a perfect agreement between the thermic indications and the chemical theories respecting the complex phenolic functions.—The treatment of mildew and rot with a mixture of lime and sulphate of copper, by M. A. Millardet. During the present season M. Nathaniel Johnston has applied this new process to 50,000 vines in the Médoc district with complete success. The plants so treated are in a perfectly healthy state, while those not treated are in a wretched condition.—On the destruction of mildew by the sulphate of copper, by M. A. Perrey. A solution of 5 per cent. of sulphate of crystallised copper has this year been successfully and economically applied to vineyards in Burgundy hitherto unsuccessfully treated with sulphur.—Ravages of mildew in the northern districts of Touraine during the present year, by M. Larreguy de Civrieux. The disease broke out suddenly a few days after a violent storm in July, attacking several varieties of the vine and the oak trees of the surrounding plantations to the exclusion of all other plants.—Note on the quadratic forms in the theory of the linear differential equations, by M. Halphen.—On the physiologic action of the salts of rubidium, by M. Ch. Richet. Subcutaneous and intra-venous injections of the chloride of rubidium applied to frogs, fishes, rabbits, guinea-pigs, and pigeons, show that this metal has the same toxic effect as potassium, but somewhat less virulent.—On the internal phenomena of muscular contraction in the striated primitive fasces in *Corethra plumicornis* and the frog, by M. F. Laulanié.—Line of development followed by the inoculated virus of tuberculosis in man, the rabbit, and guinea-pig: application to the study of inoculation and re-inoculation for tuberculosis, by M. S. Arloing.—A remarkable vegetable centre in the peninsula of Brittany, by M. L. Crié. Of this vegetable zone the characteristic species appear to be *Narcissus reflexus*, Lois.; *Eryngium viviparum*, Gay; *Omphalodes littoralis*, Leh.; and *Linaria arenaria*, D. C.—Application of thermo-chemistry to the explanation of geological phenomena; general principles; ores of manganese, by M. Dieulafait. The principle is laid down that of all the natural combinations of each metal, that which developes the greatest heat in its formation occurs most extensively in nature, and must be regarded as its principal ore. Applying this principle to the study of manganese, the author finds that the ores of this metal exist in nature in the relative proportions and under the conditions anticipated by the laws of thermo-chemistry.—On the whirlwinds observed by aëronauts, by M. Diamilla-Müller. These whirlwinds are attributed to the collision of two atmospheric currents coming from opposite directions, and are compared with the eddies produced in streams by analogous causes.—Note on a meteor observed at Saigon, Cochin-China, on August 22, 1885, by M. Réveillère.—Kinematics of the locomotion of quadrupeds: trajectories and comparative velocities of the pastern and hoof of the horse at the different phases of its motion.

STOCKHOLM

Academy of Sciences, September 16.—The following paper was presented and accepted for publication in the *Proceedings*:—"Nouvelles Observations sur les Traces d'Animaux et d'autres Phénomènes, d'Origine purement mécanique, décrits comme Algues fossiles," by Prof. A. G. Nathorst.—Experiments to determine with the galvanometer the limits of elasticity and the absolute tension of iron wire of different thickness and with varying contents of carbon, by Dr. P. Isberg.—Researches on the influence of temperature on the electromotoric force of certain electric pile combinations, by Dr. F. Kahlmeter, both the latter papers being presented and explained by Prof. Edlund.—Prof. Wittrock referred to a report left by the late Dr. Lönnroth on his botanical journey to Gothland and Östergötland, chiefly to study the Hieracia, at the expense of the Academy, and to a paper presented at a previous meeting and prepared in the Botanical Section of the Natural History Museum by Herr R. Boldt.—Contributions to our knowledge of the chlorophyllophyceæ of Siberia. He further presented and explained the two following papers, viz.:—Contributions to our knowledge of the development of the physiological tissue of some algæ, by Herr N. Wille, and contributions to the flora of the American Desmidicæ, by Herr G. Lagerheim.—Prof. Chr. Aurivillius presented a paper, "Conspectus Generum et Specierum Microceridarum," and gave a review of the same. He further exhibited living specimens of the slave-keeping ant, *Polyergus rufescens*, recently found by him near Stockholm.—Prof. Nilsson presented a paper prepared by himself and Prof. O. Petterson, "Nouvelle méthode pour déterminer la densité de vapeur des corps volatisables en même temps que la température y appliquée," and gave a review of its contents.—The Secretary (Prof. Lindhagen) presented the following papers, containing the results of researches made at the Upsala Chemical Laboratory:—On the production and nitrification of kumenylacryl acid; on the ortoderivates of kumenylacryl acid and the new indigo and chinolin-derivates obtained from the same; on the meta-derivates of kumenylacryl acid, and on derivates of kumenylacryl acid formed through substitution in the group of the acryl acid: all four by Dr. O. Widman.—Researches on the dependence of galvanic resistance in certain alloys of tin and bismuth on time, by Dr. G. Bäcklin.—On capacity of saturation and atomic weight, by Dr. J. R. Rydberg.—On Polyarsenite, a new mineral from the mine Sjögrufvan, in the province of Örebro, by Herr L. J. Igelström.—Remarks on the genus Cysteosoma, Guérin-Méneville, by Dr. C. Bovallius.—On the Lake Wettern and the formation of Visingsö, an island, by Dr. G. Holm.

CONTENTS