THURSDAY, OCTOBER 27, 1887.

THE STUDY OF EMBRYOLOGY.

An Introduction to the Study of Embryology. By Prof. A. C. Haddon, M.A. (London: C. Griffin and Co., 1887.)

THE publication of this volume supplies a long-felt want. Many will remember the pleasure with which the first appearance of an English volume solely devoted to embryology was hailed. But there was a good deal of the "lively anticipation of future favours" in the gratitude with which the public received Part I. of the "Embryology" by Foster and Balfour. The first edition of this text-book contained, it will be remembered, a clearly written, well illustrated account of what was then known of the embryology of the chick. Although the details were far in advance of anything previously published on the subject in our language, yet the explanations were so clear and the style so lucid that the book was in every way suitable for the beginner. The public was informed, in the introduction, that the work was to be extended so that it would become a text-book of general embryology. Although this promise was more than fulfilled on the appearance of Balfour's classical work, the young morphologist was to a certain extent the loser by the immense benefit thus conferred upon the more advanced student. The second edition of the former book brought the account of the development of the chick up to date, and a comparatively short description of the essential features of embryological development in Mammalia was added, but the work still remains an enlarged Part I. But in the meantime the immense and ever-increasing development of invertebrate embryology, and the magnitude of the theoretical considerations raised by its advance, rendered it more necessary than ever that the beginner should be in possession of some introduction to this part of the subject; and that the student whom time and opportunity prevented from mastering Balfour's great work should, nevertheless, be permitted to gain some insight into the subject as a whole.

Both these conditions are fulfilled, and corresponding benefits will be conferred upon morphological teaching, by the publication of Prof. Haddon's text-book. In one respect, indeed, it appears to be probable that the "Embryology" of Foster and Balfour will always remain pre-eminent as a preliminary text-book for the young embryologist. The limited scope of that work renders possible a comparatively detailed description of the growth and arrangement of the embryonic membranes and appendages, so that the relative positions of these to each other, to the embryo, and to the yolk-sac, are brought before the student with a clearness and force which could not be attained in a more condensed statement. And the great difficulty with which this part of the subject is grasped by the beginner is apt to be undervalued by the advanced student and by the teacher. Again, the selection of a single type for detailed description renders possible and indeed suggests that the succeeding stages of development should be described after the manner of a diary; and while this method strongly impresses the imagination of the reader, it gives continuity as well as reality to the shifting scenes of embryonic development. It is also probable that such a method, with its constantly repeated recapitulations, and references to events which have been previously described, must afford to the memory an assistance which cannot be given by any other system. Of course the full development of this method is totally impracticable in a volume which deals with general embryology, and the subject is not at present in a condition such that it could be adequately represented by the selection of a few types for detailed description. A book which treats of the development of those mature organisms which are usually selected as types of the morphological series is much to be desired and would be extremely useful, but in the present state of embryological knowledge it is doubtful whether such a volume would represent general embryology as completely as general morphology is represented by the types themselves.

For the reasons given above, an ideal course of embryology will begin wtth Foster and Balfour, continue with Haddon, and end, as far as text-books are concerned, with Balfour. The complete mastery in the first-named work of a single easily accessible and readily investigated type, of considerable complexity and difficulty, will enable the student to grasp the shorter descriptions in Prof. Haddon's volume of all important embryological discoveries hitherto made. Finally, a rapid survey of general embryology being thus gained, the student will pass to the longer descriptions and further details of Balfour's classical work. A course of embryological teaching so complete as this, or so well suited to the needs of the student, does not exist in any other language.

It may be objected that in any such succession of text-books there must be a great deal of waste, from the description of the same developmental histories in rather different language. For the advanced student or the investigator the objection is valid, but I believe that every experienced teacher will agree in the opinion that the young student—for whom alone such a course is necessary—gains immensely by this very fact, and learns far more by reading a second text-book which puts the same facts in a slightly different way, than by reading the first text-book a second time.

It is very high praise of Prof. Haddon's volume to place it in the middle position of such a series. It is well and clearly written, while the adoption of smaller type for theoretical questions or less important details, is a great benefit to the beginner. The figures are drawn so that the primary layers and the organs derived from them can be respectively tinted in uniform colours throughout the book. While great additional clearness will be thus conferred, the student will gain much during the process of colouring. The illustrations are very numerous, and although many of them are roughly executed, and open to exception from an artistic point of view, their meaning is sufficiently clear. In the vast preponderance of the representations of sections among the illustrations, the work only follows the example of all books on the subject in all languages, but it is to be doubted whether the course of the young student is not somewhat impeded by this universal custom. There is no doubt that, as Prof. Weismann remarked to me the other day, the art of section-cutting is a weapon for morphological research equal in importance to the discovery of the microscope itself. And embryology, far more than any other department of morphology, depends upon this art; indeed, the study may be almost said to date from the introduction of this method of inquiry. Hence there is a strong bias in favour of representing structures in section; and in original papers and advanced treatises this custom is not to be deplored, for the reader knows exactly what is meant by the figures. But even in such works I think that the reader, and the author also, would benefit by the introduction of a few additional illustrations representing the organism, organ, or structure, as a solid object. But there can hardly be two opinions on this subject in the case of an introductory text-book. The beginner cannot readily or correctly reconstruct in imagination the solid structure from a representation of a section, and he must infallibly lose considerably in time by the prevalent custom of representing in only two dimensions objects which really exist in three. Long descriptions might be curtailed, and great additional clearness conferred by the frequent illustration of solid objects, out of which a small portion is represented as cut, on one side only, so as to show the internal structure. But this necessity is not fully recognized in any embryological text-book, although some attempt is made to deal with it in this and in other works. It is to be hoped that in future editions considerable attention may be paid to this mode of illustration, which will be more than repaid by the advantage conferred upon the young student.

In conclusion, the author seems to have included everything of importance in his subject up to the date at which the book was written; so that many important discoveries or theories are described which are necessarily absent from Balfour's work. When from the necessities of space these are only briefly touched upon, the reference to the original papers is to be found in Appendix B., containing a bibliography of recently published works on embryology Hence there is reason to hope that the volume may be found useful to the student who is familiar with Balfour's work.

E. B. P.

SOME MATHEMATICAL BOOKS.

The Conic Sections, with Solutions of Questions in London University and other Examination Papers. By G. Heppel, M.A. (London: Baillière, Tindall, and Cox, 1887.)

A New Mode of Geometrical Demonstration, with Examples showing its Application to Lines and Angles, Surfaces, and the Products of Three or more Straight Lines, &c. By D. Maver. (Aberdeen: A. Brown, 1887.)

Easy Lessons in the Differential Calculus: indicating from the Outset the Utility of the Processes called Differentiation and Integration. By R. A. Proctor. (London: Longmans, 1887.)

First Steps in Geometry: a Series of Hints for the Solution of Geometrical Problems, with Notes on Euclid, useful working Propositions, and many Examples. By R. A. Proctor. (London: Longmans, 1887.)

MR. HEPPEL'S little hand-book is not a complete treatise on elementary analytical geometry as usually presented to junior students, but it is a sequel to a previous small work in the same series ("Students' Aid Series"), "On the Geometry of the Straight Line and Circle." The object aimed at in the two works is to fully equip readers for the B.A. and B.Sc. examinations of the London University and similar examinations. Hence a limited portion only is discussed, viz. the equations to the conics; tangents, polars, normals, and curvature; sections of a cone, harmonic pencils, and miscellaneous theorems. Though Mr. Heppel has treated his subject concisely, he has not done his work in a perfunctory manner, for there is much originality exhibited in his mode of treatment, and he has discussed the general equation, not only for rectangular axes, but generally, in a very clear manner. If we mistake not, this clear exposition of a somewhat difficult part of the subject—difficult, that is, to junior students—is the outcome of some years' experience in tuition. In an appendix are given "hints to students" founded on this experience, and solutions to questions, illustrative of the text, which have been taken from the London University papers. There are a few errors in the printing, but they are not of a character to seriously inconvenience the student. We could have wished for a larger page, for then more justice would have been done to the author in the presentment of some of the formulæ. A student who carefully reads the text and transfers the formulæ for the separate conics to larger pages, ought to require no other text-book than this small one for the examinations named above.

Mr. Maver claims for his method the recommendation that it is new. One can hardly expect such to be the case, but we certainly do not remember to have come across it as here applied. The nearest approximation we can lay hands upon is the method of parallel transformation, given in Petersen's "Methods and Theories for the Solution of Problems of Geometrical Constructions" (pp. 46–47); but Mr. Maver has worked out the idea at considerable length and in an elegant manner. An illustration from the principles and from the body of the work will sufficiently explain the scope of the method. "Let AB and CD be two parallel straight lines, and AC, GK, and GM any lines whatever drawn from the line AB to the line CD. If these lines, AC, GK, GM, move in the direction of the parallels AB, CD, so that CF = KL = MD, then we have the space CE = KB = GD (Euc. i. 36). Let the space CE be represented by *s*AC, which may be read space generated by AC, and so on; then *s*AC = *s*GK = *s*GM." Assuming results which readily flow from the above and which are given in the "Principles," let us now take Example II. The sides AB, BC of a triangle are bisected by CE, AF, cutting in G, to prove CG = 2EG, AG = 2FG; and if BG produced cuts AC in D, then AD = CD. "Let AF be the direction of motion, then *s*CG = *s*CF = *s*BF = *s*BA = 2*s*EA = 2*s*EG; ∴ since *s*CG = 2*s*EG, CG = 2EG. In the same way AG = 2FG. Again, if DB be the direction of the motion we have *s*AD = *s*AB = 2*s*EB = 2*s*EG = *s*CG = *s*CD; ∴ since *s*AD = *s*CD, AD = CD." There are five chapters, viz. one, containing the principles; two, applications to lines and angles; three, to squares and rectangles; four, the products of three or more straight lines; five, to lines that are in the same straight line. In an appendix the author "proves Euc. i. 36

by the doctrine of motion without any reference to the propositions of Euclid which precede it." In all, the author applies his method to forty-one examples, the treatment of which will present no difficulty to the student. If the method is not thoroughly new, it is true, and offers an interesting field for investigation.

Many of our readers have no doubt made an acquaintance with Mr. Proctor's pages already, as they originally appeared in *Knowledge*. In his preface the author states as his experience:—"I could find no interest in the differential calculus, till, after wading through 200 pages of matter having no apparent use (and for the most part really useless), I found the calculus available for the ready solution of problems in maxima and minima. This little work has been planned with direct reference to my own experience at school and college." In 114 small pages Mr. Proctor very luminously, we think, unfolds the *raison d'être* of the calculus, and by easy yet sure stages carries his reader over a good deal of ground, sufficient for a large class of students. The proofs are clear, and apparently quite level to the comprehension of a student who has a solid, but not necessarily extended, knowledge of elementary mathematics. It is a good introduction to a great subject, and is calculated to entice readers to go on further. Several well-chosen problems are fully worked out, and there are a few others for the student to tackle himself. There are not many errata, but there are slips on pp. 52, 73, 95, 109, and quite a crop on p. 110.

"First Steps in Geometry" is a reprint; it certainly well deserves an extended circulation, especially amongst intelligent mechanics and others who cannot command the assistance of teachers, for they will appreciate the way in which the writer goes about his task. His "method of showing why such and such paths should be tried, even though some may have to be given up, in searching for the solution of problems," is likely to be very suggestive to the thoughtful student. There is a vast quantity of good work in the little book, and the way in which the second book of Euclid is treated ought to find a place in our school text-books.

OUR BOOK SHELF.

The Photographer's Indispensable Hand-book. Compiled by W. D. Welford. Edited by H. Sturmey. (London: Iliffe and Son, 1887.)

THIS book is practically a complete cyclopædia on the subject of photographic apparatus, materials, and processes, &c. Those who intend purchasing articles pertaining to photography cannot do better than look through these pages, where they will find a great amount of useful knowledge and information massed together in one volume.

It would be impossible to describe the various kinds of cameras and processes, &c., which are dealt with here, but we need only add that they are profusely illustrated and well classified.

One of the latest novelties in the way of secret cameras is shown in "the watch," which, when closed, is exactly like an ordinary watch. It is opened by a spring, when a series of about half-a-dozen tubes shoot into position.

A great assortment of the different make and kinds of drop-shutters which at the present time are so largely used for instantaneous work is added.

Ueber Gemüthsbewegungen. Von Dr. G. Lange. Autorisirte Uebersetzung von Dr. H. Kurella. (Leipzig: Theodor Thomas, 1887.)

THE original essay of which this is a German translation is in Danish, and was published in 1885. The author is a Professor of Pathological Anatomy in Copenhagen, and is well known both as a practical physician and as a man of science. He does not pretend to deal fully with the complicated and difficult questions connected with the expression of the emotions. He examines, however, with much care the physical accompaniments of sorrow, joy, terror, and anger; and he offers important suggestions as to the point of view from which the entire subject can be most successfully studied. That emotions are not, in any sense which can be recognized by science, the causes of the physical phenomena associated with them is a proposition on which he lays great stress; and in support of his opinion he presents a number of arguments which deserve the attention of all who are interested in psycho-physiological studies. The German translation is very clear, and will no doubt find readers in England as well as in Germany.

Three Lectures on the Forms of Nasal Obstruction in relation to Throat and Ear Disease. By Greville Macdonald, M.D. (London: A. P. Watt, 1887.)

THESE lectures were originally delivered at the Throat Hospital, Golden Square. They do not constitute a text-book, but the author has embodied in them the results of much inquiry as to various forms of nasal obstruction. The diseases of which he treats are all of common occurrence, yet some of them have hitherto been but inadequately described, and Dr. Macdonald holds that their pathology is often totally misunderstood. His exposition, therefore, should be of service both to the student and to the general practitioner.

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 Scenery of Scotland."

THE review by Mr. A. H. Green, of Geikie's "Scenery of Scotland," published in your paper of October 13 (p. 553), does not, I think, show any accurate appreciation of the disputable points in that work. The fundamental proposition ascribed to Hutton is "that the surface features of the land are, in the main, due to the carving and sculpturing action of denudation." Mr. Green does not seem to be aware that the truth of this doctrine may entirely depend on the definition of the words "surface features," and of the subsequent words "in the main."

As there is probably no actual "surface" existing in the world which has not been weathered more or less (except the very freshest lavas), the doctrine of Hutton, when so stated, is not only true, but it is a truism. Indeed the words "in the main" might be omitted; because it would be substantially true that all "surface features" in this literal sense are due entirely to denudation.

But if the words "surface features" be understood not literally, as confined to any mere visible surface, but as applying to all forms and shapes underlying mere surfaces, then the doctrine is open to great debate, and the truth of it turns entirely on the breadth of interpretation given to the words "in the main."

Living as I do in the Highlands, I maintain that the forms of our mountains have been largely determined by their geological structure, and by faults, contortions, and subsidences in the strata of which they are composed.

I cannot argue this question here. Suffice it to say that the "Great Gutter Theory," as I venture to call it, does not, in my opinion, explain our hills or our glens. There has been, no doubt, enormous denudation. But "in the main" the forms express structure, and the effects of subterranean force.

Mr. Green refers to the "graphic illustrations" of Mr. Geikie's book. But unfortunately those illustrations are sometimes very incorrect. For example, the general view given of the south-western termination of the Highland ranges, as seen from above Gourock on the Clyde, is a view as defective and incorrect as it is possible for a geological landscape to be. I know that range of hills well, and have seen it since my childhood in every variety of light and shadow. I have also drawn it frequently, and know almost every line of it by heart. It presents a section across a great anticlinal, as was first pointed out to me by Murchison; and it is full of surface markings which reveal its structure. Not one line of these is given in Mr. Geikie's drawing. If he had been sketching a set of mole-hills he could not have made them more featureless—more utterly devoid of their distinctive forms.

Let us have facts before theories. Let us have our hills so drawn as to express the lines of structure as they are seen in Nature, and in their relation to outline. But very often the eye sees nothing except what the brain behind it has preconceived; and a geologist who draws a mountain with a theory of guttering in his head, is pretty sure to make a mess of it.

There is really nothing in the argument about an average level along the tops, as any sure indication of an original "tableland," with all its hollows due to guttering. All sedimentary materials having an average composition, when subjected to strains, pressures, or fractures, would, and must, exhibit average resulting forms. This general fact is equally consistent with more than one explanation.

I believe Mr. Geikie has modified his former views as to the action of ice. A closer inspection of the Highlands will, I am convinced, modify greatly in other ways his teaching as to the small share which structure, and subterranean force, have had in determining the physical geography of the country.

October 15. ARGYLL.

IN your last issue Prof. A. H. Green, reviewing Dr. A. Geikie's "The Scenery of Scotland viewed in Connexion with its Physical Geology," described the alleged resemblance between the Durness fossils and certain North American types as "an announcement of the greatest interest." The fact is certainly of the "greatest interest," but the "announcement" was made nearly thirty years ago by the late J. W. Salter in the *Quarterly Journal* of the Geological Society, 1858, p. 381. Mr. Salter refers to the fauna as "this truly North American assemblage," and compares the species one by one with Prof. Hall's types.

CH. CALLAWAY.

Wellington, Shropshire, October 16.

[WE have referred these letters to Mr. Green, who has sent us the following reply.—ED.]

IT is well known that the Duke of Argyll has long been a strenuous and consistent opponent of the views as to the origin of the surface features of the earth which are accepted by the majority of geologists. Indeed, if I had been disposed to be personal, I do not think that I could have quoted a more pertinent illustration than his Grace of a fact in the history of opinion to which I drew attention in the opening part of my review of the "Scenery of Scotland." He hears not Moses and the prophets, and I fear he will not be persuaded by the pleadings of one of their humbler followers; but if he will let me have my small say, I will first point out that his objection to the expression "surface features" seems to me to savour a little of quibbling. It is a general rule of criticism to interpret any ambiguous words by the context. The whole tenor of my article shows that I did not use the words in the first of the two meanings which the Duke says they may bear. Again, I am quite prepared to admit that geological structure has had a large share in determining the form of the ground; and I cannot find that either Dr. Geikie, or any other upholder of the Gutter Theory (I thank thee, Duke, for teaching me that word: no happier designation could be found), denies that subterranean force has played an important part in determining the physical geology of a country. Rather the contrary, for hear Dr. Geikie himself. He avows himself wishful that his reader should "recognize that a belief in the paramount efficacy of superficial denudation in the origin of the features of the land is compatible with the fullest admission of the existence and potency of subterranean disturbance. Inability to make this recognition," he says, "has led to absurd misconceptions and misrepresentations of the views of those who hold that the topography of the land is essentially the result of a process of sculpture" ("Scenery of Scotland," pp. 95, 96).

I will leave Dr. Geikie to take care of himself and defend the drawing the accuracy of which is impugned by his critic. I do not know the special landscape of Fig. 19, but I have enjoyed a few panoramic views of Highland scenery, and I can honestly say thus much: I have everywhere recognized those surface *markings* (may I again congratulate his Grace on the happiness of this phrase?) which indicate the geological structure of the ground beneath, but I have in every case been still more struck by that general flat-toppedness on which special stress is laid by Dr. Geikie. The comparatively slight prominence given to these surface markings in Fig. 19 will be easily understood if w bear in mind the one point which that cut was intended to illustrate.

I may add that I am extremely sorry if any words of mine seem to imply that I grudge my old friend Salter the credit due to him with regard to the Durness fossils. The expression I have used could be made to bear this meaning, and I am much obliged to Dr. Callaway for giving me an opportunity of disavowing any such intention. A. H. GREEN.

Leeds, October 20.

A Hydroid Parasitic on a Fish.

DURING my studies the past summer at the Newport Marine Laboratory I captured a single specimen of an osseous fish, *Seriola zonata*, Cuv., which exhibits a most interesting example of parasitism or possibly commensalism. Upon the outer wall of its body an extraordinary hydroid was found to have attached itself. As this mode of life is unique for a hydroid, it is thought that a mention of it, and a statement of the peculiar modifications which the hydroid has suffered, may be not without interest to others besides special students of the jelly-fishes. The hydroid is new to science, and on that account the name Hydrichthys is suggested to designate it. The hydroid will later be described and figured under the name *Hydrichthys mirus*, gen. et sp. nov.

The colony of Hydrichthys is found on the side of the body and near to the anal fin of the fish, Seriola. It forms a reddish cluster or patch of bodies, and was at first mistaken for a fungoid growth. When it was examined by means of a microscope its animal nature was easily seen and its hydroid affinities clearly made out. The fish was kept alive in an aquarium and medusæ raised from the attached hydroid. The hydroid colony is composed of two sets of individuals. These two kinds of individuals arise from a flat plate formed of branching tubes, by which the colony is attached to the body of the fish. The two kinds of individuals noticed in the cluster are the sexual bodies (gonosomes), and the "filiform bodies" (structures of unknown function).

The sexual bodies have the form of grape-like clusters of buds mounted on small contractile peduncles, which branch from a central axis or stalk. The filiform bodies are simple, elongated, flask-shaped structures, destitute of appendages, with a central cavity and terminal orifice. Neither of these two kinds of individuals have tentacles around or near a *mouth opening*, nor any structures which can be compared with these bodies, which are almost universal among fixed hydroids.

The first kind of individuals are the gonosomes or sexual bodies. They arise from the flat basal plate of branching tubes, by which the union of the colony with the outer wall of the fish is effected. Each hydroid gonosome consists of a main stem with lateral branches. At the end of each lateral branch there is a crowded cluster of small buds, which are immature jelly-fishes in all stages of growth. Each gonosome resembles a bunch of reddish and orange-coloured grapes.

The filiform bodies are simpler in structure than the sexual clusters or gonosomes. They are destitute of tentacles and are flask-like, with a cavity and terminal orifice. They are very sensitive, and move about with freedom, never, however, being detached. The fish, Seriola, was kept alive until the larger buds of the grape-like gonosomes separated from the hydroids. These buds are medusæ, different from any which I have ever seen, but with close affinities to common and well-known genera. A large glass aquarium containing several gallons of water was found to be swarming with these medusæ two days after the capture of the Seriola.

Each fully-grown medusa closely resembles the genus Sarsia. It has an oval bell, four broad unbranched radial tubes, and four long simple tentacles. There are no octocysts on the margin of the bell.

If the strange form of the hydroid was not known to me, it would have been very easy to call this medusa a near relative of Sarsia. The medusa belongs to a group, called by Agassiz the Tubularians, but its hydroid is different from that of any other member of the group.

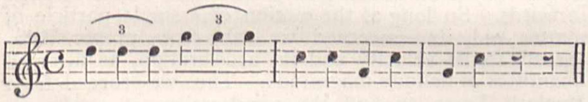
One other parasitic hydroid may be thought to be related to Hydrichthys. I refer to the Polypodium, described from the ova of the sturgeon. A description of Hydrichthys with figures of the fish (Seriola) to which it is attached, and of the hydroid with its medusa, will soon be published by me. As a discussion of its relation to other hydroids has little interest except to a specialist in the study of medusæ, a comparison of Hydrichthys with Polypodium and other genera is reserved until my complete diagnosis of the genus and species. J. WALTER FEWKES.

Cambridge, Mass., U.S.A.

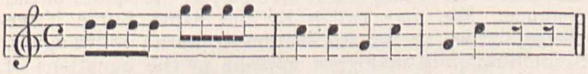
Music in Nature.

IN NATURE for August 11 (p. 343) there is an interesting article on music in Nature; the writer evidently being inclined to deny that true musical notes, and especially several notes in succession having a musical relation to one another, can be found in bird songs. However this may be in the Old World, we have in the New at least one example of a bird which not only sings, or rather whistles, pure and well-sustained musical notes, but has a succession of notes with such intervals as to form a simple melody. I refer to the scarlet tanager.

While we were at The Thousand Islands early in the summer of 1886, one of these brilliant fellows carried on a courtship among the trees close to our cottage, repeating incessantly during the first two days that we heard him the following strain,



in a clear, bright whistle. After the first two days he changed his song thus:—



and during the three weeks that we heard him he made no other variation, except that he occasionally repeated the last two notes a third time, thus filling out the bar. The notes were taken down by a trained musician, and if whistled give the tanager's song exactly.

It may be mentioned that, though perhaps the most brilliant in plumage of our Canadian birds, the male tanager referred to made no attempt at concealment, but swept like a living flame from tree to tree close to the cottage, and when singing preferred to sit on the topmost bough of a pine near by.

A. P. COLEMAN.

Faraday Hall, Victoria University, Coburg, Ontario, October 8.

Swifts.

THE following facts relating to the habits of the swifts were observed by paying close attention to these remarkable birds during the past summer. For more than a month, *i.e.* from June 1 to July 12, we watched them here. On the fine evenings about forty of them (the males I believe), ascended high into the air at about 9 o'clock, and after wheeling about for a minute or two, screaming loudly, fled straight away, sometimes in one direction, sometimes in another. White, in the "Natural History of Selborne," notices that: "Just before they retire whole groups of them assemble high in the air, and squeak and shoot about with wonderful rapidity." But the most wonderful part of the proceeding is that they do not come down again that night. At all events I can show that they do not come down again before 10.30, at which time I do not think they would be able to find their nests under the eaves of the church. Between the dates above-mentioned there were only six days during which I did not see or hear the swifts ascend and fly off. Three of these days were rainy, and the swifts stayed at home, and on three other days I was not able to watch them. The churchyard adjoins the garden of this house, and numbers of swifts build in the church, which is but a few feet from where we sit out and walk about in the summer evenings.

After seeing the high-flying swifts safely off to the south-west at 9.10 one night, I sat on a tombstone under the north eaves where most of them build, until 10.30. Two swifts hawking low for flies entered their nests after 9.10, but one of them was flying low while the high-flyers were in sight, and the other came out of its nest after they had gone, and both had retired before 9.20. On the other side of the church my father (the vicar) and my brother, who both took a keen interest in the doings of the swifts, were keeping watch alternately, and only two low-flyers were out there after the others had gone. The high-flyers did not return. On several other nights we watched until 11 o'clock, though not quite continuously, but quite closely enough to make certain that none returned. I think it most probable that owing to the darkness they do not return until the break of day, and further, that they *remain on the wing all night*. This last feat, though sufficiently startling, will, I am convinced, not be deemed impossible by those who have had good opportunities (and made use of them) for studying the ways of swifts and their wonderful powers of flight. As far as my observation goes, the swift settles nowhere except at its own nesting-place.

I shall be very glad of any information tending to throw light upon the question, and I shall be very pleased to give any of your correspondents any further information within my knowledge concerning this curious habit of the swifts, and the proofs thereof, to set out which in this letter would take up too much of your valuable space.

White also says (p. 180, original edition) he has never seen the swift carrying materials to its nest, and suggests that it usurps that of the sparrow. This does not accord with my own observation here. I have repeatedly seen swifts taking bents of grass in their beaks to their nests, and I have again and again scattered feathers on the wind from the sound-holes in the steeple, and from the steps of the cross in the churchyard, and seen them eagerly seized within a few feet of my head by numerous swifts. Their nests are neat, small, and shallow, and very firm, the materials being glued together by the viscous saliva of the builders. AUBREY EDWARDS.

The Vicarage, Orleton R.S.O., Herefordshire, October 13.

Hughes's Induction Balance.

HAVING just made a Hughes's induction balance, I have, in the course of some experiments with it, observed what was new to me, for I have not seen it mentioned in any account of the balance. I take the liberty, therefore, of asking through your columns whether the explanation resolves itself into the difference between paramagnetic and diamagnetic substances. The apertures of my bobbins are $1\frac{1}{2}$ inch in diameter; my primary current is from three Daniell's, and the break is a bent steel spring whose free point just grazes the surface of a mercury cup, so that the merest touch with a finger causes a series of regular breaks. Now, if I place an iron or steel disk, or ring, such as a key-ring, inside the aperture, the telephone sounds loudly if the plane of the disk or ring is at *right angles* to the plane of the coils; but very very faintly if it is *parallel* to the plane of the coils. On the other hand, if a disk, or ring, or coil of wire, of any of the diamagnetic metals—copper, brass, zinc, silver, gold, aluminium, lead—be used, the telephone sounds loudly if the plane of the disk or ring be *parallel* to the plane of the coils; but very faintly, if at all, when it is perpendicular to the plane of the coils. Further, if a short *bar* of soft iron, or of nickel, be inserted so that the length of the bar is parallel to the plane of the coils, almost no sound is heard; but if it be turned through a right angle so as to be perpendicular to the plane of the coils, the sound is a maximum. Have we in this simple instrument the ready means of distinguishing paramagnetic from diamagnetic substances? J. COOK.

Central College, Bangalore, S. India, September 26.

PROF. KIRCHHOFF.

GEHEIMRATH GUSTAV ROBERT KIRCHHOFF was born at Königsberg on the 12th of March, 1824. He commenced his professorial career at Berlin University as Privat Docent; became Extra-ordinary Professor in Breslau from 1850 to 1854, thereafter till 1874 Professor of Physics in Heidelberg, whence he was finally transferred (in a somewhat similar capacity) to Berlin. His health was seriously and permanently affected by an accident which befell him in Heidelberg many years ago, and he had been unable to lecture for some time before his death.

It is not easy, in a brief notice, to give an adequate idea of Kirchhoff's numerous and important contributions to physical science. Fortunately all his writings are easily accessible. Five years ago his collected papers (*Gesammelte Abhandlungen* von G. Kirchhoff, Leipzig, 1882) were published in a single volume. His lectures on Dynamics (*Vorlesungen über Mathematische Physik*, Leipzig, 1876) have reached at least a third edition; and his greatest work (*Untersuchungen über das Sonnenspectrum*, Berlin, 1862) was, almost immediately after its appearance, republished in an English translation (London, Macmillan). To these he has added, so far as we can discover, only three or four more recent papers; among which are, however, the following, published in the *Berlin Abhandlungen*:—

Über die Formänderung die ein fester elastischer Körper erfährt, wenn er magnetisch oder diëlectrisch polarisirt wird. (1884.)

A subsequent paper gives applications of the results (1884).

Additions to his paper (presently to be mentioned) on the Distribution of Electricity on two Influencing Spheres. (1885.)

While there are nowadays hundreds of men thoroughly qualified to work out, to its details, a problem already couched in symbols, there are but few who have the gift of putting an entirely new physical question into such a form. The names of Stokes, Thomson, and Clerk-Maxwell will at once occur to British readers as instances of men possessing such power in a marked degree. Kirchhoff had in this respect no superior in Germany, except his life-long friend and colleague v. Helmholtz.

His first published paper, *On electric conduction in a thin plate, and specially in a circular one* (Pogg. Ann. 1845), gives an instance. The extremely elegant results he obtained are now well known, and have of course (once the start was given, or the key-note struck) been widely extended from the point of view of the pure mathematicians. The simpler results of this investigation, it must be mentioned, were fully verified by the author's experimental tracing of the equipotential lines, and by his measurements of their differences of potential. A remark appended to this paper contains two simple but important theorems which enable us to solve, by a perfectly definite process, any problem concerning the distribution of currents in a network of wires. This application forms the subject of a paper of date 1847.

Kirchhoff published subsequently several very valuable papers on electrical questions, among which may be noted those on conduction in curved sheets, on Ohm's Law, on the distribution of electricity on two influencing spheres, on the discharge of the Leyden Jar, on the motion of electricity in submarine cables, &c. Among these is a short, but important, paper on the *Determination of the constant on which depends the Intensity of induced currents* (Pogg. 1849). This involves the absolute measurement of electric resistance in a definite wire. Kirchhoff was also the inventor of a valuable addition to the Wheatstone Bridge. To the above class of papers may be added two elaborate memoirs on Induced Magnetism (*Crelle*, 1853; *Pogg. Ergänzungsband*, 1870).

Another series of valuable investigations deals with the equilibrium and motion of elastic solids, especially in the form of plates, and of rods. The British reader will find part of the substance of these papers reproduced in Thomson and Tait's *Natural Philosophy*. There are among them careful experimental determinations of the value of Poisson's Ratio (that of the lateral contraction to the axial extension of a rod under traction) for different substances. These results fully bear out the conclusions of Stokes, who was the first to point out the fallacy involved in the statement that the ratio in question is *necessarily* 1/4.

Kirchhoff's *Lectures on Dynamics* are pretty well known in this country, so that we need not describe them in detail. Like the majority of his separate papers they are somewhat tough reading, but the labour of following them is certainly recompensed. They form rather a collection of short treatises on special branches of the subject, than a systematic digest of it. One of the most noteworthy features of the earlier chapters is the mode in which dynamical principles (*e.g.* the *Laws of Motion*) are introduced. While recognizing the great simplification in processes and in verbal expression which is made possible by the use of the term Force, Kirchhoff altogether objects to the introduction of the notion of *Cause*, as a step leading only to confusion and obscurity in many fundamental questions. In fact he roundly asserts that the introduction of systems of Forces renders it impossible to give a complete definition of Force. And this, he says, depends on the result of experience that in natural motions the separate forces are always more easily specified than is their resultant. He prefers to speak of the motions which are observed to take place, and by the help of these (with the fundamental conceptions of Time, Space, and Matter) to form the general dynamical equations. Once these are obtained, their application may be much facilitated by the introduction of the *Name* Force; and we may thus express in simple terms what it would otherwise be difficult to formulate in words. So long as the motion of a single particle of matter only is concerned we can, from proper data, investigate its velocity and its acceleration, as directed quantities of definite magnitude. Thus we proceed from Kepler's Laws to find the acceleration of a planet's motion. This is discovered to be directed towards the sun, and to be in magnitude inversely as the square of the distance. We may call it by the name Force if we please, but we are not to imagine it as an active agent. Something quite analogous appears in the equations of motion when we introduce the idea of Constraint. The mode in which the idea of Mass is introduced by Kirchhoff is peculiar. It is really equivalent to a proof (ultimately based on experiments) of Newton's *Third Law*. Once, however, it is introduced, the same species of reasoning (which differs but slightly from what we should call Kinematical) leads to the establishment of D'Alembert's and Hamilton's *Principles*, with the definition of the Potential Function, the establishment of Lagrange's Generalized Equations, and the proof of Conservation of Energy, &c. The observational and experimental warrant for this mode of treatment is, according to Kirchhoff, the fact that the components of acceleration are in general found to be functions of *position*. [Kirchhoff's view of Force has some resemblance to, but is not identical with either of, the views previously published by Peirce and by the writer.] This is the chief *peculiarity* of the book, and very different opinions may naturally be held as to its value, especially as regards the strange admixture of Kinematics and Dynamics.

Of the rest, however, all who have read it must speak in the highest terms. A great deal of very valuable and original matter, sometimes dealing with extremely recondite subjects, is to be found in almost every chapter. Among these we may specially mention the investigation of surface conditions in the distortion of an elastic solid, with the treatment of capillarity, of vortex-motion, and of discontinuous fluid motion (*Flüssigkeitsstrahlen*).

Besides these definite classes of papers, there is a number of noteworthy memoirs of a more miscellaneous character:—on important propositions in the Thermodynamics of solution and vaporization, on crystalline reflection and refraction, on the influence of heat conduction in a special case of propagation of sound, on the optical constants of Aragonite, and on the Thermal Conductivity of Iron.

Finally we have the series of papers on Radiation, partly mathematical partly experimental, which, in 1859 and 1860, produced such a profound impression in the world of science, and which culminated in the great work on the solar spectrum whose title is given above. The history of Spectrum Analysis has, from that date, been one of unbroken progress. Light from the most distant of visible bodies has been ascertained to convey a species of telegraphic message which, when we have learned to interpret it, gives us information alike of a chemical and of a purely physical character. We can analyze the atmosphere of a star, comet, or nebula, and tell (approximately at least) the temperature and pressure of the glowing gas. But, at the present time, the fact that such information is attainable is matter of common knowledge.

This is not an occasion on which we can speak of questions of priority, even though we might be specially attracted to them by finding v. Helmholtz and Sir W. Thomson publicly taking (in full knowledge of *all* the facts) almost absolutely antagonistic views. However these points may ultimately be settled, it is certain that Kirchhoff was (in 1859) entirely unaware of what Stokes and Balfour Stewart had previously done, and that he, with the powerful assistance of Bunsen, MADE what is now called Spectrum Analysis: Kirchhoff, by his elaborate comparison of the solar spectrum with the spectra of various elements, and by his artificial production of a new line whose *relative* darkness or brightness he could vary at pleasure; Bunsen by his success in discovering by the aid of the prism two new metallic elements.

P. G. TAIT.

ON THE SIGNIFICATION OF THE POLAR GLOBULES.[1]

It has long been known that the egg of some animals, after becoming mature and before undergoing its embryonic development, throws out certain bodies of globular form, which take no part in the embryonic development, but perish sooner or later. These polar globules have been found on the eggs of nearly all classes of animals, and it has been proved that they are real cells, composed of nucleus and cell-body.

Several theoretical opinions have been expressed in regard to their signification. Some naturalists believe them to be only a kind of excretion of the egg; others even think them to be of no functional importance, and perceive in them only a remnant of some ancestral process, a recapitulation of some ancient part of the phylogenetic development.

Now it is true that, in many animals, structures occur without any physiological value, but it is also known that such structures—as, for instance, the hind-legs of whales—disappear more and more in the lapse of phylogenetic development. Furthermore, such rudimentary organs never disappear in all species and genera of a large group simultaneously, but in one genus or species they persist longer than in another. Thus, some whales possess certain of the bones of their hind-legs lying between the muscles of the trunk, whilst others have preserved only one bone of the pelvis. Now the polar globules might have been regarded as insignificant and rudimentary as long as they were only known in a few groups of the animal kingdom. But as their existence is now proved in nearly all classes of animals, and as they appear in all of them in the same manner, we are compelled to assume that they possess at least some physiological significance.

Mr. Sedgwick Minot and your illustrious Balfour made a great step forward in attempting—each independently of the other—to attribute a high importance to the expulsion of the polar globules. As you know, they suggested that the egg-cell was originally hermaphrodite, and that the polar globules were the male portion, which had to be thrown off. They based their idea upon the generally accepted view, according to which fecundation is the union of a specific male with a specific female substance. If this is true, then the fecundated ovum contains both these substances in equal quantities; and the observations upon the segmentation of the egg lead further to the conclusion of E. Van Beneden, that all cells of the body contain these two substances, and that they are all hermaphrodite. The throwing out of polar globules was, according to these views, the means of preventing parthenogenesis, which must have occurred if the male substance had remained in the egg. This was Balfour's opinion, and he formulated the same with all precaution, putting it forward as a supposition, which might prove true or not. He himself even pointed out the way by which a decision could be obtained, in his statement, that, if his theory was true, polar globules would not be found in parthenogenetic eggs. Certainly, if polar globules represent the male substance, they cannot be thrown out in an egg that is not destined to be fertilized, and which therefore would not receive the male substance from another cell

Now, I have tried to decide this question by observing whether parthenogenetic eggs throw out polar globules or not, and I discovered several years ago that polar globules certainly exist in parthenogenetic eggs. I have found them in the summer eggs of Daphnidæ, and later, assisted by my pupil Mr. Ishikava, of Tokio, I have also found them in the parthenogenetic eggs of Cypridæ and of Rotatoria.

Now it is impossible that these polar globules can contain the male part of the egg, and the question arises, What other significance can be attributed to them?

When I ascertained the facts which I have just described, I was not at the time aware of another fact that I am about to lay before you, and which seems to me to possess an important bearing upon the meaning of polar globules, and of sexual propagation in general. This fact is a very simple one: Parthenogenetic eggs throw out only *one* polar body, whilst sexual eggs throw out two of them.

The importance of this fact lies in the significance of the substance that is thrown out in the polar globules or polar cells. You know well that it is a true cell-division which leads to the formation of polar globules, and that the first polar cell takes away from the egg-cell one-half of the nuclear substance. You are also aware that the second polar cell again takes away half of the nuclear substance remaining in the egg. Hence in sexual eggs three-quarters of the nuclear substance originally contained in the egg-cell are taken away by the two polar cells. In parthenogenetic eggs only one polar cell is formed, and consequently only one-half of the original mass of nuclear substance is removed from the egg-cell.

Now you know that nuclear substance is a very important thing. The experiences and reflexions of the last ten years have led to the general conviction that nuclear substance is the part that controls the whole cell, and that the entire structure as well as the functions of the cell depend upon its minute structure. The nuclear substance is the idioplasma of the botanist Nägeli. Upon the molecular structure of it the form and function of every

[1] Paper read by Prof. August Weismann before the British Association at Manchester.

cell in the body depend, and consequently the form and function of the whole body are determined by the nuclear matter or idioplasma of the first cell, the egg-cell—parthenogenetic or fertilized.

If this theoretical view is correct, then we must be astonished that so much of this important nuclear substance is lost to the egg-cell—namely, one-half by the parthenogenetic ovum, and half as much again by the sexual one. What can be the cause that renders it necessary for this to happen before the egg-cell is able to develop into an embryo?

I will give a short account of my ideas upon the subject.

(1) The nuclear substance or idioplasma of the first polar body must be detrimental to the further development of the egg, for it is thrown out in all kinds of eggs, parthenogenetic as well as sexual, and the embryonic development never begins before the first polar cell has been expelled. Now, if the nuclear substance truly controls the cell and compels it to take a certain shape and a certain histological structure, there must be such a substance, such an idioplasma, also in the youngest egg-cells. This idioplasma causes the egg to develop a yolk possessing a certain colour and structure, it causes the egg to form a shell of a certain thickness and structure; briefly, it compels the young egg-cell to attain a degree of histological differentiation which it did not previously possess. For the youngest egg-cells are essentially similar in most animals, whilst mature egg-cells are very different and can often be very well distinguished in different species. The specific idioplasma of the growing egg-cell—I call it ovogenetic idioplasma—cannot be the same as that contained in the nucleus of the mature egg, and which controls the development of the embryo. It cannot be that idioplasma which determines the development of a certain egg-cell into a duck and not into a swan; it cannot be that kind of idioplasma which I have called *germ-idioplasma*, or simply *germ-plasma*.

Of course there must also be germ-plasma in the *young* egg-cell; I believe that in the youngest germ-cells there is no other idioplasma than germ-plasma, and that this germ-plasma changes into ovogenetic plasma, only a very small part of germ-plasma remaining unaltered.

This remaining part grows with the growth of the egg, and finally attains the same volume as the ovogenetic idioplasma. Then the division of the nuclear substance takes place, and the superfluous ovogenetic substance is removed in the first polar globule, whereupon the egg-cell contains only germ-plasma.

This is my explanation of the removal of the *first* polar cell.

(2) In regard to the second it is clear that an egg that contains only germ-plasma should be capable of undergoing embryonic development, unless the quantity of germ-plasma should prove to be too small. But this is not the case. Parthenogenetic eggs enter upon embryonic development immediately after the expulsion of the first polar globule. Sexual eggs do not thus develop, and we have to inquire into the reason for this. I believe it is because they throw out a second polar cell, which takes away one-half of the germ-plasma left within the egg-cell. After this the quantity of germ-plasma is too small for entering upon embryonic development, and therefore the egg-cell remains undeveloped, unless the lost quantity of germ-plasma be replaced in the process of fertilization. Embryonic development takes place immediately after the union of the germ-plasma of a spermatozoon with the remaining germ-plasma of the ovum. Consequent upon this the quantity of germ-plasma in a fertilized egg again becomes equal to that which was present after the separation of the first polar globule, and also equal to that which enters upon embryonic development in the parthenogenetic egg.

This is perfectly simple, but a great difficulty remains. Why is it necessary that the sexual egg should throw out half of its germ-plasma; why does it not retain the whole quantity of this important substance?

You would perhaps answer, Because the quantities of male and of female germ-plasma, that are united by fecundation, must be equal. Indeed, the facts of heredity lead to the opinion that these two kinds of germ-plasma must be equal in quantity, and we have microscopical observations recorded by Van Beneden, Carnoy, and others, which further support this conclusion. But if the quantity of germ-plasma must be equal in both, why should the germ-plasma of the egg increase so largely as to attain twice the volume of the germ-plasma of a spermatic cell? Nature is not so wasteful as to throw away so important a substance for nothing. There must be an adequate cause why in sexual eggs the germ-plasma must be halved before fecundation can take place.

I believe I can point out the reason why this is necessary, but before I do so I must beg you to first enter with me upon a few theoretical considerations on the subject of heredity.

Heredity depends upon the germ-plasma, as I have said before; the minute molecular structure of the germ-plasma causes the egg-cell to develop into a duck or a swan, it also causes the egg to develop into a Negro or into a European, into a Mr. Smith or into a Mr. Jones; in short, all qualities of the developed individual depend upon the constitution of this germ-plasma. In my opinion sexual propagation implies the union of two different germ-plasmas to form the single nucleus of the egg-cell; and the two substances that are united in the process of fertilization I believe to be equal in size and quantity.

Now let us suppose that we lived at a time when sexual propagation had not yet existed, and that we were present at its origin. We should then observe the union of two different germ-plasmas, both of the same size and quantity, but of a slightly different molecular constitution, one coming from one parent and the other coming from another. Both substances must be thoroughly homogeneous—that is to say, they must be composed of particles that are equal in their chemical, molecular, and morphological constitution. Let us illustrate this by a diagram, in which we represent each germ-plasma as a thread or a loop, which we know to be the microscopical form of germ-plasma and of nuclear plasma in general. For simplicity's sake we will represent only one loop for the germ-plasma of each parent. We have then two loops, the first representing the peculiarities of the germ-plasma of one parent, and the second representing the peculiarities of the other parent, and we will discriminate between them by making the first green and the second red.

These two individual kinds of germ-plasma unite and form together the nucleus of the fertilized egg, which develops into a new individual of the second generation. This individual will form again germ-cells, and each of these germ-cells will contain a germ-plasma, which is not homogeneous, as before, but composed of two halves, derived respectively from the two parents. In each succeeding generation the germ-plasma must attain to a more complicated constitution, it must contain twice as many different kinds of germ-plasma as were contained in the germ-plasma of the preceding generation. If we follow this development of the germ-plasma for a few generations, we shall find that union will take place by sexual propagation between the germ-plasmas of two individuals of the second generation, each containing two different kinds of germ-plasma. In this way the individuals of the third generation will be formed possessing germ-cells which contain four different kinds of germ-plasma. I have called these different kinds of germ-plasma *Ahnenplasma*, a word that can be rendered in English by the term *ancestral plasma*. By sexual propagation the individuals of the third generation would give rise to individuals of the fourth generation, and the germ-cells of these last individuals must contain eight different ancestral plasmas; similarly the germ-cells of the fifth generation must contain sixteen ancestral plasmas, and so on. It is thus clear that in a very small number of generations the composition of the germ-plasma must become extremely complicated: by the tenth generation it would already contain 1024 different ancestral plasmas.

We do not know how far this may go, because we do not know how small are the primary elements of germ-plasma, nor do we know how many of these elements may be indispensable for the youngest and smallest germ-cells. But if we imagine these elements to be excessively small, this process of doubling the number of ancestral plasmas in each generation must have come to an end after a certain number of generations, whether they were 10, 20, 100, or 1000!

From the time at which the germ-plasma first attained its utmost complexity further sexual propagation was only possible by halving the number of ancestral plasms contained in the germ-plasma. Clearly, this process of halving ought to take place in male germ-cells as well as in female ones, but at this moment we are only sure of its existence in the latter. We have seen that one-half of the germ-plasma contained in the nucleus of the egg-cell is expelled in the second polar cell. That the nuclear substance thus expelled is true germ-plasma, is not a mere supposition, but a certainty. We know of developing eggs which are either fertilized or unfertilized, and in the latter case they develop by parthenogenesis. Such are the eggs of the honey-bee. We may assume that if these eggs remain unfertilized they will expel only one polar globule, but that if, on the other hand, they are penetrated by a spermatozoon they will also expel the second globule. Thus the same idioplasma that is expelled from the fertilized egg remains, and forms half of the first segmentation-nucleus in the parthenogenetic egg. It must therefore be true germ-plasma.

I do not doubt that this is the true significance of the formation of a second polar globule. We can see the necessity on theoretical grounds for the removal of half the number of ancestral germ-plasmas; and we *actually* find that half of the germ-plasma *is* removed in every sexual egg.

If this reasoning be correct, our views on sexual propagation must undergo a total change. Fertilization is no longer an unknown impulse given to the egg-cell by the entrance of a spermatozoon, but it is simply the union of the germ-plasmas of two individuals. The spermatozoon is no longer the spark which kindles the powder, or the relatively small force which converts potential into actual energy, but it is merely the carrier of germ-plasma of a certain individual, possessing the necessary qualities for reaching, penetrating, and fusing with the bearer of germ-plasma from another individual. There are no *essential*, but merely individual, differences between the nuclear substance of the spermatozoon and that of the ovum. There are no such things as male or female nuclear substances, but merely male and female cells, carriers of the immortal germ-plasma. The differences are wholly individual and of merely secondary importance, and nothing corresponding to the ordinary notions implied by the terms male and female exists in germ-plasma.

If this be so, then it is clear that the fact of sexual propagation demands a new explanation. We must attempt to explain the reason why Nature has insisted upon the rise and progress of sexual propagation. If we bear in mind that in sexual propagation twice as many individuals are required in order to produce any number of descendants, and if we further remember the important morphological differentiations which must take place in order to render sexual propagation possible, we are led to the conviction that sexual propagation must confer immense benefits upon organic life. I believe that such beneficial results will be found in the fact that sexual propagation may be regarded as a source of individual variability, furnishing material for the operation of natural selection. I believe that sexual propagation has become prevalent among the higher organisms for the purpose of conserving and multiplying that individual variability which owes its first origin to the Protozoon condition of such higher organisms. But it is not now my purpose to speak further upon this subject: I have already discussed it elsewhere ("Die Bedeutung der sexuellen Fortpflanzung für die Selections-Theorie," Jena, 1886).

Whatever is to be said for the above hypotheses, the facts I have the honour of bringing before you to-day seem at least to prove that sexual propagation depends on the removal of half of the germ-plasma of the egg and the replacement of it by the same quantity of germ-plasma of another individual. This is now a fact which may be regarded as indisputable; and, further, the existence of true parthenogenesis is now proved beyond doubt. For we know now that an egg which expels only one polar globule enters without delay into embryonic development, inasmuch as it has retained the whole of its germ-plasma.

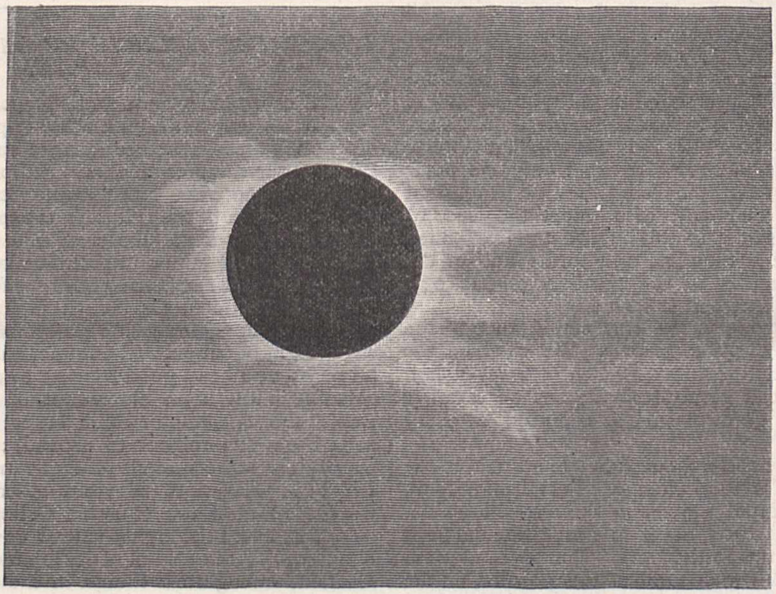
THE TOTAL ECLIPSE OF LAST AUGUST IN JAPAN.

THE eclipse has come and gone, and our little party is on its way home with a few papers and a small box of glass plates—a rather meagre showing for the hard work of our summer months. Although we were so unfortunate as to have uninterrupted cloud throughout the entire duration of the eclipse, our expedition to Japan has not been so dismal a failure all told. Apart from sundry observations of minor importance contributed by volunteer observers at scattering stations for whom I had prepared instructions, Dr. W. J. Holland, who joined the Expedition at my invitation as naturalist, has been actively engaged in botanical and entomological research in fruitful fields, and has a good harvest to report. He has also valuable notes upon his ascent of Nantaisan, Asama-yama, and Nasutake (which latter he appears to have been the first foreigner to ascend); while the separate expedition to the summit of Fuji-san (12,400 feet), which I had the pleasure to carry out under the auspices of the Boyden Fund of the Harvard College Observatory, and on which I had the highly-valued co-operation of Dr. E. Knipping, Meteorologist of the Japanese Weather Service, resulted, among other things, in the determination of its rare fitness as a site for astronomical observation—of which more elsewhere.

With reference to the preliminaries of the Eclipse Expedition it is necessary to state that early in the present year the trustees of the Bache Fund of the National Academy of Sciences, Washington, made a grant to Prof. Newcomb, the Superintendent of the *Nautical Almanac*, for observing the total solar eclipse of August 19, 1887. Prof. Newcomb determined the general lines of research to be undertaken, decided upon locating the observing-station in Japan, and placed me in charge of the Expedition. After some weeks of preparation in Washington and elsewhere, I set out for Japan on June 9, and arrived in Yokohama a month later. There was no small difficulty attending the definitive location of the instruments for observing the eclipse, owing to the deficiency of precise meteorological information regarding the region of the shadow-path. All existing data were kindly placed at my disposal by the officers of the Japanese Government, and several of the departments contributed in other ways to the assistance of an expedition which, had the skies been favourable, could not have failed of entire success.

Going northward from Tokio along the line of the Japanese Railway Company, to the courtesy of whose president, Mr. Narabara, our Expedition is deeply indebted, we pass through Utsunomiya at the distance of 65 miles, and at 113 miles reach Shirakawa, a town of about 10,000 inhabitants, and situate 10 or 12 miles north of the centre of the shadow-path. Here I found a spot forming, in many respects, an ideal location for an eclipse-station. Within a quarter of a mile of the telegraph-office and railway-station, and in an unfrequented part of the town, was the ruin of the celebrated old castle erected some 300 years ago, and occupied by the Abe family until the revolution of 1868. Permission to establish my station on the castle walls was given by Count Oyama, the Minister of State for the Army, under whose control this and similar castles elsewhere in Japan, formerly possessed by the Daimios, now are. The massive walls rise to a height of about 80 feet above the surrounding plain, and afford a capital foundation for the instrumental equipment—not to say the seclusion so desirable in the mounting and adjustment of delicate apparatus. Of the mountain-range 25 or 30 miles to the west and north-west, and its cloud-creating propensity, we had apparently little need for fear—in fact, a month's residence in the castle gave us a large proportion of afternoons on which an entirely satisfactory record of the eclipse in all its stages could have been secured.

Our main instrument was a horizontal photoheliograph of nearly 40 feet focal length, with which we hoped to expose 100 plates during the partial phases of the eclipse; but I had determined also to attempt coronal photography with the same instrument, hoping to obtain eight or ten negatives of the corona of such size that subsequent enlargement would be undesirable. At the focus of this telescope the sun's image has a diameter of 4½ inches, and dry plates 17 × 20 inches had been provided for this work. Also an extra mirror, finely silvered by Brashear, was taken along for the heliostat, to replace the unsilvered mirror ordinarily employed, shortly before totality came on. After the special modifications of the exposing-shutters and plate-holders had been made, and a light-proof tube or camera the whole length of the telescope had been constructed, periodic drill for the work of eclipse-day was at once begun. For some minutes immediately before the beginning and after the end of totality, the partial phase exposures were to be made every fifteen



seconds, while the large plates for the corona, with exposures varying from one second to sixty-four seconds, were to be handled as rapidly as possible: we found that there was a loss of about five seconds between the plates, or something like one-sixth the entire duration of totality. With a very efficient photographic corps, and the drill which we all underwent, I had the best of reasons for anticipating complete success.

As was foreseen, too, we found in photographing artificial crescents—very slender ones—that no image of the plumb-line appeared on the plate; there was thus no initial line of reference for the measurement of position-angles. Mr. Hitchcock, whom I appointed photographer of the Expedition, undertook a variety of experiments to overcome this difficulty, and with entire success; the form of apparatus finally adopted will be detailed in the report of the Expedition. To assist in the operations of the photographic house, we were fortunate in securing the services of Mr. Ogawa, of Tokio, a Japanese photographer of wide experience, and Dr. Y. May King, of Amoy, also a highly-skilled manipulator.

As wet plates appeared to me preferable in many ways to dry ones for the partial phases, Mr. Hitchcock and Mr. Ogawa instituted a thorough series of experiments in the preservation of sensitized films, at first with glycerine, and subsequently more successfully with sugar. The results of this work made the wet plate, with its fine-grained film, as available for rapid manipulation in the photography of celestial phenomena as the dry plate has hitherto been found to be. It was shown that the plates might with entire safety be removed from the sensitizing bath from two to four hours before exposure and development, if treated with the sugar preservatives, and proper precaution was taken to keep the films from drying. The details of this process will be embodied in the report of the Expedition. As an extreme test we exposed, on the day after the eclipse, a box of the plates which had been sensitized and preserved for eclipse-work some twenty-six hours previously, and found that they gave sun-pictures photographically perfect.

In compliance with orders issued by the Secretary of the Navy, two officers from the Asiatic squadron, Lieut. Southerland and Chief-Engineer Pemberton, of the U.S.S. *Monocacy*, reported to me for eclipse-duty on my arrival in Yokohama, and their services were zealously and most effectively rendered. In addition to his work as executive officer, I placed Lieut. Southerland in charge of the 9-foot coronagraph, sent out by the Pickerings from the Harvard College Observatory. The objective of this instrument was the 7¼-inch Clark glass of the equatorial of my own Observatory at Amherst, while the dry plates, with the instructions for their manipulation, were identical with those furnished by the Pickerings to Prof. Young, who carried to his Russian station a 6⅝-inch Merz glass, also lent from the larger transit-instrument of Amherst College Observatory. I have not yet been able to learn whether Prof. Young was favoured with a clear sky during totality; but, if he was, it is the more regrettable that clouds covered the sun at Shirakawa, as the first serious attempt to obtain trustworthy evidence of rapid changes in the corona has thereby come to nought. It will be many a year before another eclipse occurs with two stations geographically so well placed for this special research as were Russia and Japan. Prof. Pickering desired me, if practicable, to place all or a portion of the corona-apparatus provided by this Observatory on the summit of one of the mountain-peaks of which there are several adjacent to the centre of the shadow-path, notably Nantaisan, 8500 feet high. Dr. Holland made the ascent of this mountain about the middle of July; but his report of its difficulties, together with the highly probable cloudy condition of the summit during the eclipse, led me to abandon farther consideration of this mountain; while the other peaks were too far removed from Shirakawa to permit of occupation with the time and assistance at my disposal. The remainder of Prof. Pickering's apparatus was therefore mounted alongside the photoheliograph at the central station; the double coronagraph, two 5-inch lenses of about 3 feet focus, being operated by Dr. Ames, U.S. Navy, while Dr. D. B. McCartee attended to the exposures with the 4-inch short-focus camera, and Mr. C. R. Greathouse to the exposures of plate-holders for determining the actinic effect of the coronal light.

The valued service of Mr. Pemberton is worthy of special mention here in rendering the photoheliograph less unwieldy for rapid work than I had found it formerly. By means of an ingeniously-devised system of cords and pulleys, led from the heliostat into the photographic house, the reflecting mirror was placed under the immediate and constant control of the chief astronomer making the exposures: it was thus possible to dispense with the customary assistant at the heliostat pier for adjusting the mirror in right ascension and declination. A very simple device made it possible to see the bright reflected image of the sun while at my post in the dark room, and adjust it accurately on the plate without opening the exposing-slide.

The importance of Newcomb's and Langley's observations of the outer corona in 1878, and attempted by Lockyer in 1886, had not escaped me, and I had an occulting-disk mounted on a rod attached firmly to the gable of the photographic house, so that its shadow as cast by the eclipsed sun would fall about 50 feet away, in the area inclosed by the upper castle wall. Here I stationed Mrs. Todd, provided with all the paraphernalia for seeing and sketching in their correct relations the faint outlying streamers of the corona.

Of two 3½-inch telescopes lent by Admiral Yanagi, Hydrographer of the Imperial Japanese Navy, one was reserved for the optical observation of first and fourth contacts, and the search for intra-Mercurial planets; while the other was committed to Dr. Holland, a skilled artist, with instructions to sketch as far as possible all the details of the corona adjacent to the solar poles.

Mr. Nakagawa, the Director of the Naval Observatory, with his assistant, made a thorough series of meteorological observations throughout the eclipse period, following the system elaborated by Von Bezold and recommended by the German Meteorological Conference for the observers in Russia. On the north-west corner of the castle wall I stationed Mr. K. Açino, a student of astronomy in the University, to make detailed and precise observations of the diffraction bands, and to observe if possible the sweep of the lunar shadow across the extensive rice-fields below.

The purely eclipse results of the work at Shirakawa were disheartening in the extreme. The forenoon gave us a perfect sky, with no indication whatever of approaching cloud: all were confident of entire success. But about an hour before the time of first contact, a slender finger of cloud began to rise from the west, coming at first directly above the summit of Nasutake, a volcano about 25 miles away, and which had sprung into unwonted activity during the past night, belching forth for hours enormous volumes of smoke and steam. The sun was entirely invisible during the first half-hour of the eclipse, when a brief interval of partly clear sky gave time for adjusting the heliostat and making ten or twelve exposures. The sun being very faint, only five of these photographs are available for measurement; and these were the only pictures that could be taken with the photoheliograph. The dense clouds, leaving a large clear area most of the time about the zenith, lay over the sun until the eclipse was past, save only a moment shortly after totality, when there was a partial clearing, but too brief, and the sun too faint, to allow of the necessary adjustment of the reflecting mirror.

As totality drew near, it suddenly occurred to me that a good observation of second contact might be possible by watching for the approach of the moon's shadow among the clouds; but my attempt to do this failed, the light appearing to me too much diffused to permit of anything better than a rough approximation to the time of contact. I found subsequently among Mrs. Todd's notes of the eclipse that totality appeared to her to come on, not evenly, but as if by jerks—a phenomenon which may, I think, have been due to the extinction of the sun's light from one cloud after another, as the lunar shadow advanced over the north-western sky. The weather-map for August 19, which came to our station from Tokio the day after the eclipse, gave us some idea of the odds we had been labouring against: the sheet for 2 p.m. showed clouds at all stations of the Meteorological Service except one, and that far removed from the belt of totality. In general, the whole of the main island was obscured on the eventful afternoon, and a view of the eclipse was permitted only to those so fortunate as to be located in the line of the small apertures, here and there, through the general cloud area. These were numerous enough to enable voluntary observers, scattered over the central portion of the belt of totality, and for whom I had prepared instructions, to obtain a goodly number of drawings of the corona. These instructions had been translated into Japanese, and printed and distributed through the co-operation of the Department of Education and the Bureau of Geography of the Department of the Interior. Altogether there are something like a hundred such drawings; but their value is uncertain until they are properly collated. Much the best drawing which I saw was made by Mr. Shuji Isawa, Chief of the Bureau of Compilation of the Department of Education, who was fortunate enough to be located in a spot in Western Japan, where totality was seen in a nearly cloudless sky. He has kindly furnished me with photographs of his drawing, one of which is inclosed.

Other Expeditions in Japan fared ill also—some of them worse than my own. That sent out from the University in charge of Prof. Terao, and located a few miles south of Shirakawa, at Kuroiso, experienced not only heavy clouds, but much rain during the eclipse, and no observations could be made. At Sanjo, on the central line and south-east of Niigata, Prof. Arai, Director of the Meteorological

Observatory, was able to make successful exposures for the corona with a small telescope. It was reported clear during the whole eclipse at Choshi, a point on the eastern coast near the southern limit of total obscuration, but there were no observers or instruments there for scientific work. It was reported cloudy throughout the whole eclipse at Niigata; while a party of observers who had ambitiously climbed to the top of Nantaisan brought down a record of nothing but clouds and fog. On the whole, Japan appears to have been an uncanny spot to lead an eclipse-track across. DAVID P. TODD.

s.s. *Port Victor*, September 20.

THE MÄRJALEN SEE.

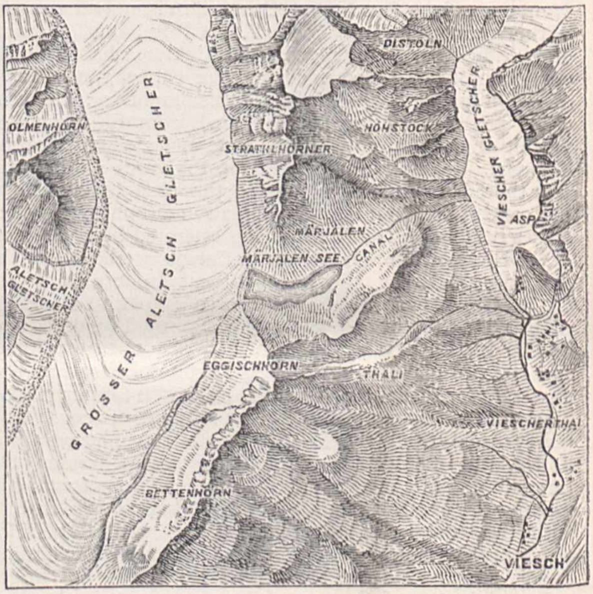
LAKELETS, in which the ice-crags of a glacier are mirrored, in which miniature bergs may be seen to float, are of occasional, though of rare, occurrence in the Alps—as for example the Lac de Ste. Marguerite, at the foot of the Ruitor glacier; but the Märjalen See, so far as I know, is unique of its kind. It is not formed at the foot of a glacier, either by partial occupation of a shallow basin worn by the ice-stream in its days of greater strength, or by the pounding back of the glacier torrent by an old terminal moraine; but it is on one side of a glacier, which makes a dam across an upland glen. This barrier at times yields to the pressure of the accumulated water sufficiently to allow of its escape beneath the great ice-stream, and it is a recent incident of the kind, noticed in the *Times* of September 30, which has suggested the present article.

The Great Aletsch glacier, as is well known, is the largest ice-stream not only in the Oberland group, but also in the Alpine chain. Its upper basin is fed by the snows of an almost complete ring of grand peaks, the most conspicuous of which, enumerated from west to east, are the Aletschhorn, the Jungfrau, the Mönch, and the Viescherhörner. All these are considerably above 13,000 feet, and there are several others, less familiar to the ordinary tourist, which either rise slightly above that elevation, or are only a very few hundred feet below it. The great *eismeer* thus formed passes out as a single stream through a "gate in the hills," between the crags of the Faulberg on the east and the base of the Dreieckhorn on the west. This gap is rather more than a mile across, and the glacier for several miles is not less, and is generally rather more, than its breadth at this place. It flows at first slightly to the east of south, then runs almost due south, and finally sweeps gradually round to the south-west. This deflexion is caused by the Eggischhorn, which rises like a great pyramid full in face of the upper course of the glacier to a height of 9649 feet above the sea, or nearly 2000 feet above the surface of the ice. At this spot the Märjalen See is situated, at a height of 7710 feet above the sea, rather less than five miles below the "gate," and rather more than that distance above the end of the Aletsch glacier. This sweeps on along the west flank of the Eggischhorn, until it terminates in the grand gorge of the Massa, at no great distance from the Bel Alp Hotel, a worthy rival in beauty of situation to that on the Eggischhorn.

The Märjalen See is thus formed: the range of the Eggischhorn is continuous with that which makes the left bank of the Aletsch glacier, and divides its comparatively unbroken surface from the narrower and more shattered mass of the Viesch glacier. But this range to the north of the Eggischhorn is deeply notched, so that it is possible to quit the Aletsch glacier and without ascending to reach a depression, barely so high as the surface of the ice, from which one looks down a steep slope on to the surface of the Viesch glacier. From this depression a shallow valley descends towards the west, and is barred, as mentioned above, by the great glacier of the Aletsch. Thus a lake is formed, fed by various streamlets from the slopes on either side and by the melting of the glacier ice. Though now the shrunken stream of the Aletsch glacier does not diverge towards the lake, it was no doubt formerly divided by the opposing mass of the Eggischhorn; then one of its arms occupied the bed of the lake, and after passing over the depression joined itself to the Viesch glacier. Some geologists regard the basin of the Märjalen See as wholly due to the excavatory action of this offshoot of the Aletsch. To myself it appears to be the upper part of a valley, produced in the ordinary way, but subsequently modified in its outlines by the rasping action of the glacier.

At somewhat irregular intervals, but according to popular belief once in seven years, the ice-dam yields sufficiently to allow the pent-up waters to escape beneath the glacier, when the contents of the lake are discharged rapidly down the gorge of the Massa, and, after devastating the fields below, are poured into the Rhone, near Brieg.

In the summer of 1858 I had the good fortune to see the Märjalen See both full and empty. On my first visit I found a lake full 300 yards across at the lower end, and



about three times as long. From the rocky margin on either side the ice arched up in a low flattened curve until its edge at the highest point was about 60 feet[1] above the level of the water. From this it rose in a vertical cliff of almost unbroken ice, of purest white, which was mirrored in the still blue water below. Here and there miniature icebergs were floating, in colour if possible yet purer than the parent glacier, and above the water at the foot of the cliff was a band of turquoise blue. This was produced by the fresh surface of the ice, for the cliff is under-cut by the action of the water of the lake, and to this undercutting the bergs are no doubt partly due.

Next evening I revisited the spot. To my surprise all was changed: the lake had almost wholly disappeared; the glacier cliff which the day before had been doubled by reflexion, was now doubled in reality. Below the upper zone of white ice was now a zone of more than

[1] Probably the height at the present time is not so great. Since 1858 there has been a considerable shrinking in the glaciers of the Alps. When I visited the Märjalen See in 1881, the greatest height of the cliff did not appear to me to exceed 30 feet. In 1858 Prof. Ramsay found by measurement that the greatest height of the cliff above water was 60 feet, and the greatest depth of the lake at its foot 97 feet ("Peaks, Passes, and Glaciers," 1st series, p. 461).

equal thickness of the most exquisite blue; on the dry bed of the lake were stranded the bergs which the day before had floated in its waters, and we could now appreciate their true size. One whose shape we had greatly admired now appeared even more beautiful with its fantastic pinnacles and blue recesses. It was, I estimated, from 30 to 40 feet high, nearly as wide, and considerably longer. Two cubical masses on the opposite shore were in colour the most lovely turquoise blue that I have ever seen. These, no doubt, on the previous day had appeared as mere slabs on the surface. The bed of the lake was covered with a fine mud, on which were numerous tracks or castings, which I attributed to a worm. I did not see any shells, so that probably no mollusks live in the chilly waters of the Märjalen See.[1]

The ice in this part of the Aletsch glacier is comparatively little crevassed. This permits the glacier to act as a dam; the drainage of the lake is no doubt due to some accidental rupture which opens a communication, quickly enlarged by the running water, with the sub-glacial drainage of the glacier.

A traveller in August 1872 was so fortunate as to see the actual escape of the water at the lower part of the glacier. He describes it as follows[2]:—"It was 4.50 p.m. when we arrived (at the Bel Alp Hotel). The domestics drew our attention to a sound like the roar of a cataract, which seemed to descend the Aletsch. For a time the sound was sub-glacial, but a yellow torrent at length appeared on the opposite side of the glacier, smoking and roaring as it tumbled down the declivities of ice. The front of the torrent soon appeared opposite to the Bel Alp, carrying every movable thing along with it. Wishing to get near the torrent, I descended rapidly to the glacier, crossed it, and succeeded in getting quite close to the rushing water. Everywhere impetuous, it was divided into spaces of tolerably uniform slope, separated from each other by steep and broken declivities, down which the water plunged with tremendous fury. At the base of one of these falls it was met by a kind of reflecting surface, by which the rhythmic character of the motion was finely revealed. The water here was tossed upwards in a series of vast parallel fans, carrying with them ice-blocks and stones, and breaking above into a spray as fine as smoke. A bend of the glacier came in for the lateral portion of this spray, and over it the rounded blocks of ice and the stones were showered like projectiles. The sound of the torrent had not abated at bed-time, but this morning all is quiet, and no water is to be seen in the temporary channel."

This sudden discharge of so great a body of water, in addition to damaging the fields immediately below, very considerably raises the level of the Rhone. On the last occasion, September 4, the writer quoted at the beginning of this article states that "the level of the Rhone rose at Brieg 5½ feet, from about 3½ feet to 9 feet, and at Sitten 4 feet, from 6½ feet to 10½ feet. The greatest rise observed since the regulation of the Rhone from the same cause took place on July 19, 1878, and although it was then at Brieg only 5 feet, and at Sitten only 3 feet, it was considered a very fortunate circumstance that the event took place at a very low level of the Rhone for the season."[3] He adds that to avoid such a danger in future it is proposed to enlarge greatly a channel which many years since was cut through the moraine stuff overlying the rock east of the lake, and so provide an outlet towards the Viesch glacier. By this "the volume of its waters will be reduced to about half what it is at present (10,000,000 cubic metres)." So that future travellers will not see the Märjalen See in its full beauty. The lake formed by the advance of the Gétroz glacier, in the upper part of the Dranse valley, the bursting of which in 1818 wrought such fearful devastation, may be regarded as to some extent a parallel case with the Märjalen See, of a more temporary nature, but on a grander scale.

[1] Ramsay found the temperature of the water near the ice-cliff to be 3° C.

[2] J. T. quoted from the *Times* in *Alpine Journal*, vol. vi. p. 100.

[3] An account of this is given by F. V. Salis (*Jahrb. Schweiz. Alpencl.* 1878-79, p. 549. The discharge on this occasion was at first slow. It began at 8 a.m. July 18; by 4 p.m. the lake had sunk 1 metre; during the darkness it sank 4 metres, and by 3 p.m. most of the contents were gone. It was estimated that only 700,000 cubic metres of water out of 10,000,000 remained.

In Sir Charles Lyell's "Principles of Geology" (chapter xvi.), and again in his "Antiquity of Man" (chapter xiv.), are notices of the Märjalen See, and of some beach terraces formed by its waters. He regards it as illustrative of the celebrated parallel roads of Glenroy, but, though this explanation has found very general favour with geologists, I must confess myself unable to accept it. But into this thistle-bed of controversy I must not permit myself to wander.

T. G. BONNEY.

THE BACILLUS OF MALARIA.

A PAPER of unusual interest in relation to the question of the agency of microphytes in the production of disease will shortly appear in Prof. Cohn's botanical *Beiträge* (vol. v. part 2). For many years the efforts of pathologists have been directed in this relation to the subject of malaria. The local conditions which determine the "endemic" prevalence of ague have been studied with considerable exactitude. They are such as to indicate very clearly that the material cause of intermittent fever, although it is generated in the soil, acts through the air. The fact that its influence is restricted within very narrow limits of distance from its source indicates that it is not diffusible like a gas or vapour, but consists of particles which, on various grounds, are surmised to be living organisms of extreme minuteness. Can this be established on evidence which will bear criticism?

All will remember that in 1879 Tommasi Crudeli published (in conjunction with Prof. Klebs) observations which tended to show that in malarious districts a Bacillus inhabits the soil which can be cultivated so as to yield a product capable, when inoculated, of producing in animals a fever of intermittent type, accompanied by the anatomical characteristics of malarious infection. Subsequently it was found by several observers that, during the cold stage of ague, spore-containing Bacilli, conjectured to be identical with those of Crudeli, are to be found in the blood.

These results have been received by pathologists with much misgiving, partly because the experimental proofs appeared inadequate, partly because other observers failed in their endeavours to verify them. Dr. Schiavuzzi, a medical practitioner at Pola, on the Adriatic, appears to have been more fortunate. Following the methods of Dr. Koch, he has sought for organisms in the air of the malarious district near the town in which he resides, and with such success that he is able, in repeated observations, to obtain without fail pure cultivations of a Bacillus which is not only indistinguishable as regards its structure from that of Crudeli, but also produces in animals the characteristic symptoms and pathological changes which belong to ague. The first communication of Dr. Schiavuzzi's results was made to the Accademia dei Lincei more than a year ago (see *Rendiconti*, vol. ii. 1886, April 4), but excited very little attention. It so happened that in the course of the past summer Prof. Cohn visited Pola, and so became acquainted with Dr. Schiavuzzi, who, during the present year, has been pursuing his investigations. In consequence, Prof. Cohn has been able to repeat the Pola experiments in his own laboratory at Breslau, and, so far as possible, to confirm the discovery. The writer had the opportunity, a short while ago, when Prof. Cohn was in England, of reading the proofs of Schiavuzzi's paper, and of seeing the very perfect photographs of the Bacillus which have been made of it at Breslau.

Although it may be admitted that evidence of a more conclusive kind than any which has been offered by Dr. Schiavuzzi is required to establish the truth of his inference, yet there seems to be good reason for thinking that he has approached much nearer to a solution of the question than any of his predecessors. J. B. S.

NOTES.

AT the meeting of the Academy of Sciences, Paris, on the 17th inst., Admiral Mouchez spoke of the preparations which are being made for executing the photographic charts of the heavens. Ten of the photographic telescopes, seven by MM. Henry and Gautier, of Paris, and three by Sir H. Grubb, of Dublin, are expected to be finished by the end of 1888 and forwarded to various observatories in France, Spain, South America, and Australia. With the promised co-operation of England, the United States, and Russia, it is hoped that a good beginning will be made in 1889, and that the vast undertaking will be completed within the time anticipated by the International Congress of last April.

PROFS. CAYLEY, F.R.S., AND M. J. M. HILL retire from the Council of the London Mathematical Society. The new names selected by the Council for submission to the Society at its annual meeting (November 10), are those of Mr. A. Buchheim and Dr. J. Larmor. The De Morgan Medal, which we have already announced as awarded to Prof. Sylvester, F.R.S., will be presented to him at the aforesaid meeting.

ON December 8 next, Herr Friedrich Traugott Kützing will be eighty years of age, and a good many men of science in Germany are anxious to give emphatic expression on the occasion to their respect for his character and their appreciation of his labours. Herr Kützing was one of the first to recognize that the best material for the study of cells and their life is provided by the simplest plants; and the results of his researches are well known to all biologists. It is proposed that a gift of some kind shall be presented to him on his eightieth birthday, and an influential Committee has been appointed to make the necessary arrangements. If any English students of biology would like to associate themselves with their German colleagues in this matter, they should communicate with the secretary of the Committee, Herr Otto Müller, 44 Köthenerstrasse, Berlin, W.

M. NOLAN, student at the Geological Laboratory of the Sorbonne, has been intrusted by the French Ministry of Public Instruction with a mission to study the geology of the Balearic Islands.

A NOTIFICATION in the *Calcutta Gazette* states that the Maharanee of Cossimbazar has given twenty thousand rupees for the promotion of technical education in the Moorshedabad district. The donor of this munificent sum proposes that five thousand rupees shall be spent in purchasing the necessary apparatus and instruments. The interest on the remainder is to be devoted to endowing a class in the Berhampore Collegiate School, and establishing classes in connexion with the college class in some of the neighbouring elementary schools. The Lieutenant-Governor of Bengal accepts the gift, and approves of the scheme proposed by the Maharanee.

AN interesting address on English and foreign technical education was delivered last Saturday by Prof. Silvanus Thompson, at the Aldingham Institute, a school of technical education in Goldington Crescent, St. Pancras. In the course of his address Prof. Thompson drew attention to the fact that in Berlin there is a great State-aided institution in which every known industry is taught. This institution he described as a large building—as big as Buckingham Palace, if not quite so beautiful—standing on a site of about 12 acres. It had something like 500 rooms for technical teaching, and, in fact, was a perfect college, with a good library. He believed that the entire cost of that establishment had been about £960,000. It was a building which had cost about the same amount as one of our ironclads. The entire maintenance of the institution was about £38,000 per annum; but that expenditure and the original outlay were recouped by the well-to-do character of those who had passed through its teaching, and thus had become useful members of society instead of drags upon the country. For such a country as England a site not of 12 acres but of 40 acres would be required. It might cost £4,000,000 to build and £100,000 a year to maintain, and from the results which would follow it would be cheap at the price, for it would enable us to obtain every possible requirement of life from our own handicraftsmen, instead of having to go to foreign countries for what we need. It would do more, for the superiority of English workmanship would cause fresh demands to be made from us, not only throughout our own colonies, but from foreign countries also.

THE Geodynamical Committee of the Italian Meteorological Society held meetings at Aquila from September 6 to 8. A preliminary meeting had been held at Florence in May last to prepare the work of the present one. The object was to formulate practical and uniform directions for the seismological researches undertaken by the Society, and to deduce from our actual knowledge rules to be followed in the construction of houses, so as to diminish the risk of damage in earthquakes and undulatory motions. M. Bertelli, of Florence, explained the theory of his new bifilar instrument for determining the least tremors of the earth, and he was invited to prepare directions for its construction, erection, and use, to be added to the report of the discussion. He also described his apparatus for the protection of telephones from lightning. The choice of a type of seismograph was the subject of a long discussion, and a Committee was nominated for the study of this very important question. The consideration of the best mode of collecting, discussing, and publishing the seismic and micro-seismic observations now being made in Italy was referred to the same Committee. On the consideration of the rules to be followed in the construction of buildings, M. de Rossi, of Rome, indicated the further observations which ought to be made. MM. Denza, De Giorgi, Roberto, Bertelli, and Galli also took part in the discussion. The resolutions adopted will be printed, and distributed to the various municipalities for the instruction of the persons concerned. This meeting of students of seismology is the first that has been held in Italy. The Secretary of this enterprising Society is Dr. O. L. Bianco.

THE other day the Committee of the Chester Society of Natural Science passed a resolution, which was entered in their minutes, expressing their deep sense of the loss the Society had sustained through the death of Mr. John Price, which took place on Friday, the 14th inst. He had reached the ripe age of eighty-four. Upwards of forty years ago, when residing at Birkenhead, Mr. Price occupied himself with the fauna of the Birkenhead shore, and the value of his researches was recognized by various scientific investigators of acknowledged eminence. The last of his observations on the shore were embodied in a paper on the pluteus of the starfish, read before Section D of the British Association meeting at Liverpool in 1852. To the Proceedings of Section D of the British Association he contributed papers from time to time at subsequent meetings. Having settled at Chester in 1858, Mr. Price was soon the means of establishing in the city a Society for the study of natural history. Ten years later, after the appointment of the late Charles Kingsley to a canonry in the Chester Cathedral, this Association was merged in the present Society, founded by Mr. Kingsley, who was one of Mr. Price's intimate friends. Mr. Price accepted, and retained until his death, the position of Chairman of the Botanical Section of the Society. The resolution to which we have referred concludes as follows: "We shall miss from our meetings and excursions his venerable form, his familiar voice, and his wise counsels, but the name of 'Old Price' is one which will ever live in the Society as that of one of our revered fathers, and one of Nature's truest disciples and humblest and most loyal children."

THE last number of the Journal of the Royal Asiatic Society (N.S. vol. xix.) contains a short paper by Prof. de Lacouperie on the Miryeks, or stone men of Corea. These are huge half-length human figures, carved in stone, and looked upon as relics of a religion of former times. Those described by Mr. Carles in his paper on Corea, read before the Royal Geogaphical Society last year, are about 25 feet high, cut out of some large boulders in the middle of a fir wood in a hill-side. The largest hitherto known is at Unjin, and is shown in a plate prefixed to the paper. It stands about 62 feet high; and the body and head resemble those of the idols in Buddhist temples. A column about 10 feet high runs up from the head, giving support to an oblong slab about the same length; on this stands a smaller column supporting another slab, and from the corners of the two bells are pendent by chains. Prof. de Lacouperie points out some peculiarities about the word Miryek, and suggests that perhaps it is not Corean at all; it may have existed in Corea in its special adaptation to the huge stone statues, without having preserved its original meaning previous to the adoption of Chinese characters. If this be correct, it implies that the religion which produced the erection of the statues was then forgotten or in the shade. They might, he suggests, be due to an early spread of Buddhism in Corea. But it is evident that we must know more of that country before the origin of these curious survivals is clearly explained.

ANOTHER contribution to our knowledge of the group of beautiful dye colouring matters known as safranines has just been published in the current number of the *Comptes rendus* by MM. Barbier and Vignon. It has been known for some time that the nitroso-derivatives of the tertiary aromatic monamines in acting upon the primary monamines give rise to colouring matters, but their nature has hitherto remained undetermined. MM. Barbier and Vignon, however, in the light of their previous work, set out to explore this interesting side group of substituted safranines, with the following successful result. Starting with para-nitroso-dimethyl aniline, $C_6H_4NON(CH_3)_2$, they studied the action of one equivalent of its hydrochloride upon one equivalent of aniline in alcoholic solution, and found that a reaction occurred sufficiently violent to boil the alcohol. Eventually the product dissolved, forming a solution at first yellow, afterwards gradually changing to brown, and finally to bright violet-red, which on cooling deposited a solid. After filtration, washing, and repeated recrystallization this solid was obtained pure in brilliant brown crystalline spangles. Analysis showed that its composition was $C_{16}H_{20}N_4$, and from its reactions there can be little doubt that it is tetra-methyl diamido-azo-benzene. It is not very soluble in water, but, as is characteristic of all the safranines, is soluble in concentrated acids, forming deep-red or violet solutions. This, however, is not the only substance formed during the above reaction, for sodium chloride precipitated from the violet mother-liquor a second crystalline colouring matter, which turned out to be identical with the well-known dimethyl phenylene safranine, $C_{20}H_{18}N_4$. The formation of this latter body helps to explain the course of the reaction, which probably runs as follows: $3[C_6H_4NON(CH_3)_2HCl] + 2C_6H_5NH_2 = C_{16}H_{20}N_4 + C_{20}H_{18}N_4HCl + 3H_2O + 2HCl$. The work of MM. Barbier and Vignon, and of all other workers in this direction, is the more interesting inasmuch as it combines industrial utility with the advancement of pure chemistry, on the one side handing over new materials to the manufacturer, and on the other new facts to the already immense number which stand to the credit of the last few years.

THE *Times* reprints, from a document issued by the Berlin Bureau of Statistics, some interesting information about what is called "the motive force of the world." It appears that four-fifths of the engines now working in the world have been constructed during the last twenty-five years. France owns 49,590 stationary or locomotive boilers, 7000 locomotives, and 1850 boats' boilers; Germany has 59,000 boilers, 10,000 locomotives, and 1700 ships' boilers; Austria 12,000 boilers, and 2800 locomotives. The force equivalent to the working steam-engines represents—in the United States, 7,500,000 horse-power; in England, 7,000,000; in Germany, 4,500,000; in France, 3,000,000; and in Austria, 1,500,000. In these figures the motive power of the locomotives is not included, whose number in all the world amounts to 105,000, representing a total of 3,000,000 horse-power. Adding this amount to the other powers we obtain the total of 46,000,000 horse-power. A steam horse-power is equal to three actual horses' power; and a living horse is equal to seven men. The steam-engines of the world represent, therefore, approximately the work of 1,000,000,000 men, or more than double the working population of the earth, whose total population is supposed to amount to about 1,455,923,000 inhabitants. Steam has accordingly trebled man's working power.

IN the report presented at the eighteenth meeting of the Sunday Lecture Society it is stated that the attendance at the lectures during the last session was less than in the previous year. The Committee also announce that the accounts show an increased balance against the Society. On the other hand, they note with pleasure that good progress is being made by kindred associations in various parts of the country.

A SERIES of elaborate "geological studies," relating to the Dutch West Indies, by Prof. K. Martin, of the University of Leyden, is being issued by E. J. Brill, of Leyden. These "studies" embody the results of researches which Prof. Martin himself has carried on. In the first instalment, which has just been issued, he deals with the geology of Curaçao, Aruba, and Bonaire. This instalment consists of 140 handsome, well-printed pages, and is illustrated by three coloured geological maps, two plates, and thirty-six woodcuts.

A VALUABLE "Statistical Atlas of India," prepared for the Colonial and Indian Exhibition, 1886, and printed at Calcutta, may now be obtained at Mr. Edward Stanford's, Charing Cross. The object of the work is to give a general idea of the character of the country, its inhabitants and agriculture, with the addition of such statistics as may serve to illustrate commercial and educational progress. The maps have been prepared and printed in the office of the Surveyor-General of India at Calcutta, under the special supervision of Colonel Waterhouse and Major Strahan; and the chapters are by writers specially conversant with the subjects with which they deal.

MESSRS. CASSELL AND CO. have ready a new and enlarged edition of "Colour," a scientific and technical manual treating of the optical principles, artistic laws, and technical details governing the use of colours in various arts, by Prof. A. H. Church; and cheap editions of "The Fresh-water Fishes of Europe," by Prof. H. G. Seeley, F.R.S., and "Short Studies from Nature," a series of familiar papers, by eminent authors, on interesting natural phenomena, with full-page illustrations and diagrams.

NEW catalogues of scientific books have just been issued by Messrs. Macmillan and Bowes, Cambridge, Messrs. Dulau and Co., London, and Mr. W. P. Collins, London.

THE Cambridge Scientific Instrument Company have published a descriptive list of "anthropometric apparatus," consisting of instruments for measuring and testing the chief physical characteristics of the human body. This list cancels those previously issued. The instruments have been designed under the direction of Mr. Francis Galton.

A BIOLOGICAL and Microscopical Section has been formed in connection with the Cardiff Naturalists' Society, with Dr. C. T. Vachell, M.D., as President, and Prof. W. N. Parker as Hon. Sec. The inaugural meeting was held on Thursday evening, October 20, in the Biological Department of the University College, when papers were read on the work of the Section by the President and Hon. Sec. The objects of the Section are stated to be the promotion of the study of biology generally, but more especially of the local flora and fauna, including marine as well as land forms.

IT is announced that the following lectures will be delivered at the Royal Victoria Hall, Waterloo Bridge Road. November 1, Mr. A. H. Gilkes, "The First Napoleon;" 8th, Mr. W. L. Carpenter, "Heat" (experiments by means of the projection lantern); 15th, Dr. H. W. Crosskey, "Early Changes in the Earth's Surface and how we get our Knowledge of them;" 22nd, Sir John Lubbock, M.P., "The Habits and Ideas of Savages;" 29th, Mr. W. F. Donkin, "Mountain Climbing in Switzerland and the Caucasus;" December 6, Prof. Boyd Dawkins, F.R.S., "A Bit of Coal;" 13th, Dr. W. D. Halliburton, "The Eye, and how we See."

THE additions to the Zoological Society's Gardens during the past week include two Nisnas Monkeys (*Cercopithecus pyrrhonotus*) from West Africa, presented by Mrs. Benett Stanford; a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mr. Edward A. B. Pitman; a Dusky Ichneumon (*Herpestes pulverulentus*) from South Africa, presented by Mr. L. G. Morrell; a Three-striped Paradoxure (*Paradoxurus trivirgatus*) from India, presented by Mr. J. Millar; a Buzzard (*Buteo vulgaris*), British, presented by Mr. F. Austen; a Pennant's Broadtail (*Platycercus pennanti*) from New South Wales, presented by Mrs. Brooks; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mr. Absell; two Burrowing Owls (*Speotyto cunicularia*) from South America, presented by Mr. John Clarke Hawkshawe, F.Z.S.

OUR ASTRONOMICAL COLUMN.

THE PARALLAX OF Σ 2398.—In the *Astronomische Nachrichten*, No. 2676, Dr. E. Lamp, of Kiel, has published a determination of the parallax of the brighter component of this pair (to which his attention was attracted by their large proper motion) referred to two neighbouring stars derived from a series of differences of declination observed with the refractor and filar micrometer of the Kiel Observatory between February 1883 and April 1885; the value of the parallax deduced from this discussion being 0″·34. Wishing to verify this result, Dr. Lamp has made with the same instrument, between May 1885 and March 1887, a further series of measures of differences of declination of each component of Σ 2398 (= D.M. + 59°, No. 1915, mags. 8·2 and 9·0 respectively) referred to three comparison-stars: viz. D.M. + 59°, No. 1911, mag. 7·0; D.M. + 59°, No. 1913, mag. 9·4; and D.M. + 59°, No. 1918, mag. 7·8; and has published the results of his discussion of these measures in Nos. 2807–8 of the above-mentioned periodical. The following tabular statement gives for each series of observations the resulting parallax deduced from the differences of declination between each component of the double star and each of the above-mentioned comparison-stars:—

Period.	Component.	π_1	π_2	π_3	No. of Measures.
		″	″		
1883–84 ...	Σ_1 ...	— ...	+0·2958 ...	+0·3801	46
1884–85 ...	Σ_1 ...	— ...	+0·2517 ...	+0·4628	44
1885–87 ...	Σ_1 ...	+0·3601 ...	+0·2656 ...	+0·4303	73
1885–87 ...	Σ_2 ...	+0·3808 ...	+0·2636 ...	+0·4199	73

It would appear from this that Comparison-star No. 2 has a sensible parallax relative to Comparison-stars Nos. 1 and 3, and we hope that Dr. Lamp will proceed to investigate it independently. Meanwhile, combining the results obtained from the three stars, the mean parallax is—

for Σ_1 = 0″·3520 ± 0″·0140
and for Σ_2 = 0·3548 ± 0·0131,
or the mean parallax of the system Σ 2398 = 0″·353 ± 0″·014.

NEW MINOR PLANET.—A new minor planet, No. 271, was discovered on October 13 by Dr. Knorre, of Berlin.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 OCTOBER 30—NOVEMBER 5.

(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 30

Sun rises, 6h. 52m.; souths, 11h. 43m. 46·2s.; sets, 16h. 36m.: right asc. on meridian, 14h. 17·7m.; decl. 13° 47′ S. Sidereal Time at Sunset, 19h. 11m.

Moon (Full on October 31, 22h.) rises, 16h. 38m.; souths, 23h. 12m.; sets, 5h. 58m.*: right asc. on meridian, 1h. 47·3m.; decl. 6° 0′ N.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.	
	h. m.	h. m.	h. m.	h. m.	° ′
Mercury .	9 21 ...	13 16 ...	17 11 ...	15 49·9 ...	23 5 S.
Venus ...	3 2 ...	9 8 ...	15 14 ...	11 41·4 ...	0 23 N.
Mars ...	1 21 ...	8 13 ...	15 5 ...	10 46·2 ...	9 29 N.
Jupiter ...	7 31 ...	12 14 ...	16 57 ...	14 48·3 ...	15 17 S.
Saturn ...	22 15* ...	6 2 ...	13 49 ...	8 34·7 ...	19 2 N.
Uranus ...	4 42 ...	10 20 ...	15 58 ...	12 53·9 ...	5 5 S.
Neptune.	17 36* ...	1 18 ...	9 0 ...	3 49·8 ...	18 18 N.

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

Occultations of Stars by the Moon (visible at Greenwich).

Oct.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.
			h. m.	h. m.	° °
30 ...	33 Ceti ...	... 6 ...	0 58 ...	1 44 ...	193 275
30 ...	35 Ceti ...	... 6½ ...	1 54 ...	3 3 ...	149 325
Nov.					
1 ...	μ Ceti ...	... 4 ...	2 34 ...	3 38 ...	109 355
3 ...	B.A.C. 1351 ...	6½ ...	4 19 ...	4 30 ...	217 235
3 ...	75 Tauri ...	... 6 ...	6 41 ...	7 21 ...	89 5

Variable Stars.

Star.	R.A.	Decl.			
	h. m.	° ′		h. m.	
U Cephei	0 52·3 ...	81 16 N. ..	Nov. 2,	3 10	*m*
o Ceti	2 13·6 ...	3 29 S. ...	,, 5,		*M*
T Arietis	2 42·0 ...	17 2 N. ...	,, 4,		*m*
η Geminorum ...	6 8·1 ...	22 32 N. ...	Oct. 30,		*M*
ζ Geminorum ...	6 57·4 ...	20 44 N. ...	,, 30,	4 0	*m*
			Nov. 3,	4 0	*M*
U Hydræ	10 32·0 ...	12 48 S. ...	,, 3,		*m*
S Coronæ	15 16·8 ...	31 47 N. ...	,, 3,		*m*
V Ophiuchi	16 20·5 ...	12 10 S. ...	Oct. 31,		*M*
W Herculis	16 31·2 ...	37 34 N. ...	Nov. 4,		*m*
U Ophiuchi	17 10·8 ...	1 20 N. ...	,, 2,	2 23	*m*
		and at intervals of		20 8	
β Lyræ	18 45·9 ...	33 14 N. ...	Nov. 2,	22 0	m_2
η Aquilæ	19 46·7 ...	0 43 N. ...	,, 1,	0 0	*m*
W Cygni	21 31·8 ...	44 52 N. ...	,, 1,		*m*
δ Cephei	22 25·0 ...	57 50 N. ...	,, 3,	3 0	*m*

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

GEOGRAPHICAL NOTES.

LIEUT. WISSMANN, the well-known African explorer, has arrived at Brussels from his journey across Africa. He was accompanied as far as Nyangwé by Lieut. Le Marinel, the route followed being different from that traversed by Wissmann on his first journey. He did not, however, succeed in penetrating the region to the north of the Sankuru, nor in reaching the somewhat mysterious Lake Lundi.

IN the *Bulletin* of the Hungarian Geographical Society, vol. xv. fasc. 7, will be found an interesting paper (abstracted in French) on the struggle for existence among plants in the Hungarian Pusztas (steppes).

To the *Bulletin* of the Belgian Geographical Society, No. 4, 1887, M. Louis Navez contributes an instructive paper on the influence of the various geological formations in Belgium, especially upon the people. M. Navez points out that Belgium is specially favourable for such an investigation. In France and Germany the great differences of altitude and latitude, and the diversity of climate, determine phenomena often difficult to distinguish from those which are really due to geology, and are therefore causes of error. In Belgium the differences of altitude, of latitude, and of climate are not of so much importance. The influence of the character of the soil is almost always preponderant, and is easily distinguished. One instance may be given. The great quantity of lime which the Cretaceous soil of the Geer valley contains gives to the straw of the cereals a special suppleness, strength, and whiteness. From this straw are manufactured plaits which have a large sale, and in Paris are ranked next to the straw of Italy for ladies' bonnets. This manufacture is worth from four to five million francs yearly. On the other hand, the absence of calcareous salts in the ground traversed by the feeders of the Lys, render that river eminently suited for the cleansing of flax; hence the fame of the cloths of Flanders. M. Navez believes that the facts he brings together prove that the geological construction of the ground is one of the factors that limit the free will of man and have an active influence on communities.

IN Dr. Oscar Baumann's paper on Fernando Po, in No. ix. of *Petermann's Mitteilungen*, the author states that the volcanic group of which the island is a member, forms a line running south-west from the Cameroons, and may be regarded as the result of an eruptive fissure, which on the one side extends from the Cameroons to the island of Annobon, and on the other appears to find in the Rumbi Mountains a continuation into the heart of Africa. The northern half of the island is covered almost entirely by the huge volcanic peak of O-Wassa (Clarence Peak). After careful estimation he gives the summit a height of 9350 feet. The volcano may be regarded as extinct, the fire and clouds of smoke seen at times on the summit being easily explained by the annual burning of the grass. The crater on the top of the mountain is 515 feet in depth, and is inclosed by gray disintegrated walls of basalt. On the thickly wooded and almost impassable slopes are many subsidiary craters. The basaltic rock of the east coast is being gradually crumbled away by the sea, while along the west coast the land is gaining on the sea. The physical geography of the southern half of the island is determined by the mountain range of the "Cordillera of Fernando Po," which in two chains connected by a pass runs practically east and west. These chains culminate in several summits, which have a volcanic character only on account of their basaltic composition. In the south of the island, and apparently quite independent of the Cordillera, there rises a lofty volcanic mass. On the top of one cone-shaped peak, precipitous on all sides, there extends a flat basin surrounded by a circle of hills. This the author supposes to be the remains of a large crater.

M. A. J. WAUTERS writes a long article in the new number of the *Mouvement Géographique* to prove that Lake Muta-Nzigé, the somewhat problematical lake to the south of Albert Nyanza, belongs to the Congo system, and not to that of the Nile. The altitudes and other data which M. Wauters has on which to base his conjecture are of the scantiest, and extremely doubtful. It seems to us that such conjectural arm-chair geography is a useless waste of time and space. The question of the relation between the Muta-Nzigé and the Albert Nyanza can only be solved by actual exploration. By this time no doubt it has been solved either by Emin Pasha or Stanley, and M. Wauters might therefore put the valuable space of his small journal to a much more profitable use.

METEOROLOGICAL NOTES.

THE Hydrographer to the Admiralty has issued a circular stating that the United States Government has given notice that from September 1, 1887, the following storm signals (consisting of day signals of two kinds, also night signals), would be shown on the shores of the Atlantic Ocean, Gulf of Mexico, and Great Lakes, as storm conditions may demand, taking into consideration the fact that westerly winds of high velocity with clearing weather are less dangerous than those from easterly quarters with freezing weather: (1) cautionary signal, a *yellow flag with white centre*, will indicate the winds expected are not so severe but that well-found and seaworthy vessels can meet them without great danger; (2) storm signal (now in use), a *red flag with black centre*, will indicate that the storm is expected to be of more marked violence. In order to afford as exact information as possible regarding the relative positions of the storm and the winds expected, two pendants will be displayed: a *red pendant* will indicate easterly winds, from north-east to south inclusive, and that the storm centre is approaching; a *white pendant* will indicate westerly winds, from north to south-west inclusive, and that the storm centre has passed. Whilst it is intended that the pendant shall indicate positively only whether the winds will be easterly or westerly, yet in order to give still more definite information, the *red* or *easterly pendant* will be hoisted above the cautionary or storm signal, for winds from the north-east quadrant, and below for winds from the south-east quadrant. Also, the *white* or *westerly pendant* will be hoisted above the cautionary or storm signal for winds from the north-west quadrant, and below for winds from the south-west quadrant. Because of the difficulty of varying night signals, they will not distinctly show the force, but indicate the direction of the wind only; a *red light* for easterly winds, and a *red and white light* for westerly winds.

THE Pilot Chart of the North Atlantic Ocean, issued by the Hydrographic Office at Washington for the month of September, includes a valuable article on the law of storms, considered with special reference to the approaching season of West Indian hurricanes. The article is accompanied by two diagrams illustrating (1) the circulation of the wind in a tropical cyclone in the northern hemisphere, showing clearly how the wind is drawn in towards the centre of low barometer, and its direction at any point; and (2) a diagram for practical use in finding a ship's position relatively to the centre of the hurricane, by means of the direction of the wind and fall of the barometer. The circles in this diagram are normal isobars, and represent the rate at which the barometer falls as the centre of the storm is approached, so far as our latest knowledge of cyclones can be safely used as a general guide. Full directions are given for the practical use of these diagrams. The Pilot Charts contain frequent extracts from ships' logs, as to the great value of the use of oil in heavy seas, and the Hydrographic Office considers that the testimony is so conclusive that its use is now recognized by every commercial nation. The Charts contain information about winds, currents, fog, and the position of dangerous derelicts, and their speedy dissemination must prove to be of great utility to the maritime community generally.

THE *Annalen der Hydrographie und maritimen Meteorologie* for August contains a graphical representation of the distribution of rainfall in the Atlantic and Indian Oceans, compiled by Dr. W. Köppen from materials at the disposal of the Deutsche Seewarte and all other available sources. The latitude is shown in the vertical, and the months in the horizontal direction; each point of the area of the diagram therefore indicates a definite time of the year, and a definite distance from the equator, and the curves show the equal percentages of days of rainfall. The diagrams are explained in the text, and show the relatively large rainfall frequency in the higher latitudes of the North Atlantic in all seasons, but especially during winter; further southwards, towards the region of the trade-winds, all months become drier, but north of the tropics rain falls on an average once in every 5–10 days. In the South Atlantic the conditions are more complicated. From 0°–5° S. autumn rains are prevalent, and from 5°–14° S. the winter rainfall maximum is prominent. In the Indian Ocean the equatorial rain-belt is considerably widened, especially on the southern side. From 2° N. to 12° S. the rainfall frequency does not fall below 50 per cent. in any month, and from June to October it exceeds 70 per cent. Between 10° and 12° S., and also from 25°–30° S. the spring-time is driest; while from 33° S. the rainfall increases rapidly in winter and spring. South of 40° S. it rains eight days out of ten during July and August.

Symons's Monthly Meteorological Magazine for September contains interesting articles on the deficiency of rainfall this year and on the definition of drought. From a comparison of the rainfall at 27 stations from January 1 to August 31, 1870-79, and for the same period in 1887, and expressing the difference of 1887 from the average as a percentage, it appears that the mean percentage this year has been: for England 59·8, for Wales 60·0, for Scotland 68·5, and for Ireland 60·3. Out of 11 stations in England the drought is unprecedented at 6, in Scotland at 6 stations out of 8, and in Ireland at 5 stations out of 6. Scotland has suffered least, and in parts of England the deficiency has reached the extreme limit that may be expected. There appears to be no good definition of a drought. In 1880 Mr. Symons adopted a classification for his numerous observers, which has generally been used up to the present time, viz. (1) absolute drought, being a period of 14 or more consecutive days without rain; (2) partial drought, being a period of 28 or more consecutive days in which the total rainfall did not exceed 0·25 inch. But engineers speak of droughts varying from 140 even to 240 days; these can bear no comparison with the above definitions, and Mr. Symons suggests a third term, viz. long drought, being a period of not less than 60 days with a total rainfall of not less than 2 inches. Opinions are wanted as to how the records of rainfall observers may be best utilized in the form most useful to engineers.

MR. J. W. OLIVER has contributed an article to *Longman's Magazine* for October on the moon and the weather, in which he discusses some of the most important of the popular predictions in which the moon is concerned. He deals (1) with the lunar notions that are utterly absurd, and (2) with those that are explicable by the aid of physical principles. The conclusion at which he arrives is that there is more nonsense than sense in lunar predictions, but that it is unfair to consider the whole subject as unworthy of serious treatment. For instance, atmospheric tides due to the moon's attraction must exist, although generally obliterated by disturbances due to other causes. The author apparently favours Sir John Herschel's statement of the tendency of the full moon to clear the sky, and in support of that theory he quotes the experiments of Melloni and others, showing that moonlight contains a minute proportion of dark heat rays, the effect of which may in a certain measure cause the dispersion of the clouds. The lunar halo is also referred to as an old sign of bad weather. Of 61 halos observed near London 34 were followed by rain within 24 hours and 19 within four days. In the *Mittheilungen aus dem Gebiete des Seewesens* for June, published by the Hydrographic Office of Pola, Capt. C. von Bermann has an article upon the same subject. He deals chiefly with Herr Falb's attempt to reinstate the moon's influence in his work "Das Wetter und der Mond." The result arrived at is that, although the moon has an influence on the weather, it is too infinitesimal, compared with other influences, to be appreciable.

THE Annual Report of the Meteorological Observer for Tasmania for the year 1886 gives the results of observations taken at 11 stations and rainfall reports from 37 stations.

THE SIXTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY IN VIENNA.

(FROM OUR OWN CORRESPONDENT).

THE most important questions dealt with at the Vienna Congress were those relating to preventive medicine, a branch of medical science which originated with Edward Jenner's discovery of immunity from small-pox by means of vaccination. The high value of vaccination and re-vaccination was clearly shown in the Demographic Section of the Congress by statistical tables exhibited by T. Körösi, the Director of the Statistical Office in Buda-Pesth. According to these tables the mortality of the not-vaccinated patients treated in nineteen Hungarian small-pox hospitals was 800 per cent. larger than that of the vaccinated patients, while the receptivity for getting the disease was three and a half times larger in the not-vaccinated as compared with the vaccinated people. In the Fourth Section the question of vaccination was also submitted for discussion by a lecture delivered by a Turkish delegate, Dr. Violi, and a resolution recommending to all Governments the introduction of compulsory vaccination was unanimously adopted.

Thanks to the valuable discoveries of Pasteur, the method of protecting the life and health of men as well as animals by vaccination has been worked out more extensively, and is now applied with the best success against various desolating and destructive diseases. The beneficial effects of the various methods of preventive inoculations, the amount of saving of human and animal life brought about by their use, will easily be perceived by a sketch of the discussions which were held at the last meetings of the Third Section of the Congress.

A special sub-section was formed where the special results obtained by the preventive inoculations in splenic fever, and erysipelas of the pig, were reported and discussed upon. Dr. Lydtin, of Carlsruhe, gave an interesting account of the development of the measures against the different plagues, alluding also to the defects of repressive measures, by which cattle-trade and cattle-breeding are so severely affected. While two centuries ago the first trials made of providing immunity against sheep-pox and other plagues were based on purely empirical views, the recent bacteriological discoveries have led to the scientific method of vaccination with an attenuated virus. Dr. Chamberland, Pasteur's assistant, reported on the results obtained by the preventive inoculations against (charbon) splenic fever in France, Hungary, Italy, and Russia. In the year 1886, 367,208 of sheep and 47,229 of cattle had been subjected to anti-charbon inoculations. Chamberland's statements were considerably supported by the results obtained with Pasteur's methods in Switzerland and at Pakisch, Prussia, which were communicated by Dr. Custer of Zurich and Dr. Lydtin (Carlsruhe). On the other side, the practical value of the preventive inoculations in splenic fever was severely contested by Dr. Löffler, of the Berlin School. An animated discussion on this subject went on for three hours and a half.

By the majority of the speakers it was pointed out that no loss by death—or only a small percentage of such loss—was caused by the inoculation itself in cattle, and that the number of cases of natural splenic fever decreased very much after the preventive inoculations; but in sheep the vaccinations against charbon were not equally favourable. As to the duration of the immunity acquired by the vaccination no positive statements could be made.

Then the usefulness of preventive inoculations against charbon symptomatique (Rauschbrand) was dealt with, and was acknowledged by all the speakers. In the course of the discussion on the preventive inoculations against erysipelas in the pig—a discussion in which Drs. Lydtin, Chamberland, and Prof. Czokor of Vienna, took part—it was stated that by the inoculations the animals get immunity against the disease, but that further improvements of the method are wanted, as there is now a considerable loss of inoculated animals by the vaccination itself, and sometimes the spreading of disease in healthy animals. In conclusion it was resolved on a vote that the experiments on preventive inoculations against splenic fever, charbon symptomatique, "erysipelas of the pig," and the other epizootics ought to be continued under the control of and assisted by Governments.

The battle-ground of the Congress from a scientific point of view was the discussion on the preventive inoculations against rabies. Dr. Chamberland gave a *résumé* of the development of Pasteur's method, and the results obtained by this treatment in France. 2682 persons were treated and the average mortality was only 7·5 per cent.; while the mortality of persons bitten by rabid animals if not inoculated varied between 5 and 30 per cent., according to the statements made by different authors. In answering the objections made by some recent writers who had expressed the opinion that the death of patients from hydrophobia was caused by the inoculations themselves, he maintained that it was proved by experiments made with the spinal cord of those persons that the death was caused by the bite of the rabid animal, not by the inoculations. If animals were inoculated with brain emulsions of those persons they became rabid, but they died on the fourteenth or fifteenth day after inoculation, while they would have succumbed on the seventh day if the death of the persons had been caused by the inoculated virus.

Dr. Bordoni-Uffreduzzi of Turin, in making experiments on dogs and animals, found that various parts of the brain of rabid animals show different degrees of virulence. The pancreatic gland is nearly as virulent as the brain, while the liver and spleen seem to act much less strongly as media of the virus. He had also treated 119 persons bitten by rabid dogs; three of them died.

Dr. Emmerich Ullmann, assistant of Prof. Albert of Vienna, has performed preventive inoculations in 122 persons. Only persons who could prove by documents the rabid condition of the biting animal were submitted to the treatment, and only the weak inoculations were used. The rabid condition of the biting animal was in all the cases proved either by experiments with the brain of the animals or by *post-mortem* examinations. Out of the 122 patients treated, whose ages varied between fourteen months and sixty-one years, threedied; the rate of mortality being 2·4 per cent. In fourteen cases the wounds were on the head or in the face. To this series belonged two deaths; while in seventy-two cases the upper extremity was the seat of the wound, in which group the third death occurred. As Pasteur had laid great stress on the previous cauterization of the wounds, Dr. Ullmann was carrying out some experiments to examine the influence of cauterization. Animals were infected subcutaneously with the virus of rabies, and then treated with cauterizations by lapis infernalis or fuming nitric acid. All these animals died from rabies, even when the cauterization was applied immediately after the infection, as could be shown by experimental inoculation with their brains. Only two animals cauterized on the spot with the Paqueline (ferrum candens) remained healthy. The eminent value of the preventive inoculations could easily be ascertained by some of the cases treated by Dr. Ullmann. In *Rzeszow*, a Polish village, five persons were bitten by a rabid dog. Three of them were brought to Vienna, where they were treated by Pasteur's inoculations; they remained healthy, while the two others remaining at home not inoculated died from hydrophobia after two weeks. Also in some other cases, persons bitten by rabid dogs but not submitted to Pasteur's treatment died, while the inoculated persons bitten by the same animal were not attacked by the disease. These experiments seem to be crucial experiments, proving clearly the usefulness of Pasteur's method.

It may be also stated that Dr. Ullmann had to defray the expenses of his experiments and of the inoculations from his own pocket, as the Austrian Government refused to grant any subvention for carrying out Pasteur's experiments, "on account of the frequent mishaps"! It is impossible to say from what source the Government obtained knowledge of these mishaps, as it did not try to get any information on the matter either in Paris or in Vienna. On the other side, the Hungarian Government has acknowledged the high merits of M. Pasteur by conferring on him the Order of the Iron Crown.

Dr. von Frisch criticised the statistical data given by Pasteur and Chamberland. He argued that there should be a decrease of cases of rabies if the method were successful; but the number of cases has increased. The fixed virus is an inconstant power, the period of incubation after its inoculation being a various one, not restricted to seven or eight days. Inoculation after previous infection does not provide certain immunity. The compulsory inoculation of dogs should be introduced to prevent rabies in man.

Prof. Metschnikoff, the celebrated Russian biologist, reported on the results obtained at the Bacteriological Station of Odessa. 713 persons, bitten by rabid animals, had been treated by Dr. Gamaleia. At first the results obtained were unfavourable, too weak emulsions having been used for the inoculations, as was proved by later experiments. Since July 1886, 532 persons were treated by the intensive method. In 137 out of these 532 cases, emulsions weaker than of two-days' incubations were injected; 9 persons died, the rate of mortality being 6·5 per cent. Of 88 persons inoculated once with a two-days' virus, 2 died (*i.e.* 2·3 per cent.); while among the last 307 cases, treated at least twice with a two-days' emulsion, only 2 deaths (0·6 per cent.) occurred. The average mortality in all these 532 cases was 2·4 per cent. The value of the intensive treatment could easily be understood in the case of persons bitten by rabid wolves. Of 36 persons bitten by rabid wolves, 6 were subjected to the weak treatment, and 2 of them died; the other 30, inoculated with two-days' virus, remaining healthy. In some cases even the one-day's virus was used with the best results; *e.g.* among 5 persons bitten by rabid wolves, inoculated six times with one-day's virus, the outbreak of rabies had been prevented. Experiments on 1500 animals were carried out by Dr. Bardach, who was able to prove the correctness of Pasteur's statements regarding the seven-days' period of incubation of his fixed virus. In some cases, however, the period of incubation was found to be prolonged; but the prolongation was caused by some other parasitic diseases of the animals, which will be described by Dr. Bardach in a forthcoming paper. In concluding his report, Prof. Metschnikoff stated that "the results obtained at the Odessa Bacteriological Station are very strongly in favour of Pasteur's discoveries, which decidedly must be regarded as epoch-making."

Dr. De Renzi (Naples), described his experiments on rabbits, in which, by the injecting of brain-emulsion into the blood-vessels, rabies had been produced. But neither by this method nor by subcutaneous injections of the fixed virus was he in every case able to produce rabies in rabbits, which sometimes showed immunity against this infection. He expressed also the opinion that no gradual difference of the attenuation of the virus seems to exist.

In summing up the different views of the speakers Dr. Chamberland was able to state that the high value of Pasteur's discoveries was acknowledged by everybody.

THE MINERAL WEALTH OF THE UNITED STATES.

ON Saturday, October 8, a lecture on this subject was delivered at the American Exhibition by Dr. A. E. Foote, of Philadelphia, who, as Acting Commissioner from Pennsylvania, has exhibited a fine collection illustrating the mineral resources of that great State. The Chairman, Mr. F. W. Rudler, President of the Geologists' Association, congratulated the audience upon being able to listen to one who, from his very extensive and personal observation, was well qualified to treat such a subject.

Dr. Foote pointed out that the geological formation of a country was the basis of its mineral wealth, and illustrated this by the remarkably fine large geological map of the United States compiled by Prof. Hitchcock from the work done by the United States and State Geological Surveys. His statistics were mostly based upon Williams's "Mineral Resources," of 1885.

As a Pennsylvanian he was happy to say that of 95,000,000 of tons of coal mined in that year nearly two-thirds the tonnage, and fully two-thirds the value, was produced in Pennsylvania. Of this amount 34,000,000 of tons was anthracite. The Girard Trust, that noblest of America's educational charities, exhibits a mass of anthracite from their mines in Schuylkill County, Pennsylvania, that measures 22½ cubic feet, and weighs 2256 pounds. Coal is now found in workable quantities in thirty States and Territories. Of iron there was less in value mined in 1884 than the value of the petroleum—£4,000,000 sterling—but with the steady revival of business the production has rapidly increased, until this year it may reach a total of £6,000,000 sterling. The iron area is being developed almost as rapidly as the coal. The greatest activity has been manifested in Alabama, near Sheffield and Birmingham. The latter city is the most wonderful example of rapid, solid business development that America has ever seen. Perhaps nowhere else in the world can such a favourable combination of coal, iron, and limestone be found.

But for the remarkable development of natural gas near Pittsburg, far more of Pennsylvania's capital would have been transferred to this favoured locality. Natural gas was first used for lighting the town of Fredonia, New York, in 1825, and this well, still in operation, was pronounced by Humboldt an eighth wonder of the world. Here, however, it was used simply for lighting, but it is far better suited for heating, owing to the absence of the heavy hydro-carbons. It is principally marsh-gas, ethane, hydrogen, and nitrogen. In October of 1875 it was first used in the smelting of iron at the mills of Spang, Chalfant, and Co., at Etna, near Pittsburg. The gas was brought 17 miles from the "Harvey," the leading well of the region. When turned into the 6-inch iron pipe the pressure was so great that it travelled the entire distance in twenty-two minutes. Mr. Foote visited the works in December 1875, and it was already in full and successful operation, turning out the purest iron, equal to the best Swedish. Its success was so striking that it was almost instantly introduced into all the iron, glass, and other manufactories of this great centre of America's industry. It is also used in all the heating and lighting of the city. The cost is about one-quarter that of coal, and it is estimated that it will this year take the place of coal to the value of £6,000,000 sterling. Not the least of its advantages is its freedom from smoke, so that what was once an unbearably dirty city now has air as pure as that of a country village. The enormous waste that has been going on is illustrated by the history of the "Haymaker" Well, No. 1, which in five years wasted £400,000 worth of gas, or nearly £200 daily. There were hundreds of such wells.

Gold and silver were touched upon very briefly, as others who were present were expected to speak upon them. The production of gold was £6,500,000. Of this the larger portion was from quartz-mining, the placer production having very much fallen off owing to the unfavourable legislation in California. The speaker referred to the tellurides as true ores of gold, and predicted that while at present they were found in large quantities only in Colorado, they would be found in much greater quantities north and south. The production both of gold and silver would undoubtedly be increased as transportation facilities were increased in localities now nearly inaccessible. The placer mines of North Carolina and Georgia had, he believed, a great future before them. A successful process was required for working the enormous dry deposits of Arizona and New Mexico without water. The silver production is over £10,000,000 sterling. The rich deposits of Leadville (Colorado), the Comstock mines in Nevada, the Silver King and other localities in Arizona, Silver City and Lake Valley (New Mexico), were referred to. At the latter a chamber was found not much larger than a common room from which £100,000 worth of ore was taken. It was chloride, so rich that it would fall in drops of nearly pure silver with the heat of a lighted match.

The American copper mines are the richest in the world; the production being over £4,000,000 sterling, of which the "Calumet and Hecla" claims one-fifth. They have over seventeen years' supply in sight, and practically the supply is inexhaustible. The "Anaconda" of Montana, and neighbouring mines, also produce about one-fifth. These localities are so rich, so easily worked, and above all so accessible, that the extraordinarily rich mines of Arizona, where transportation is much more costly, have suffered severely by the competition. The mines near Clifton (Arizona) produce a charming combination of malachite and azurite, which is one of the most beautiful ornamental stones ever seen. At the Copper Queen mine malachites fully equal to those of Russia, and azurites as finely crystallized as those of Chessy, France, are found.

The lead production is of the value of £2,100,000 sterling, most of which is a by-product of the Rocky Mountain silver mines. This production is so great that it has rendered mining for lead alone unprofitable at the wonderfully rich South-West Missouri region. A very interesting fact is that the vanadates and molybdates of lead replace the phosphates in all the western region. As vanadium salts are rapidly increasing in importance in the manufacture of the aniline dyes, this will be a future source of wealth, for there are mines here that can produce more vanadium than all the rest known in the world. The molybdates from Arizona and New Mexico are the finest ever seen.

The production of zinc was £1,000,000 sterling, three-quarters of which is found in South-West Missouri and Kansas. Four railroads have been constructed within a few years to carry away the rapidly-increasing production. The zinc mines of Franklin, New Jersey, have been known for over a hundred years and are remarkable not only for their richness but for the extraordinary number of rare and beautiful species that are found there and nowhere else in the world. The localities of mercury, nickel, manganese, tin, chromium, platinum, and other metals were also spoken of.

Among non-metallic minerals the phosphates of South Carolina were the principal, over £750,000 sterling being produced annually for fertilizers. Vast deposits of gypsum or plaster-stone are found in Michigan, Ohio, New York, and other localities. Mica is principally mined in New Hampshire and North Carolina. This is the mineral popularly but erroneously known in England as talc. Talc is a very different material, also found in North Carolina, but used for the tips of gas-burners and as a lubricator. The principal use of mica is for the windows of coal-stoves. Many very interesting minerals occur in connexion with the mica, such as beryls of enormous size, emeralds of great value, garnets, and so forth.

The time was so fully taken up with the ores and economic minerals that the gems and ornamental stones were treated of in a lecture delivered on October 22.

THE EXPLORATION OF NEW GUINEA.

ON August 11 (p. 351) we reprinted from the *Sydney Morning Herald* an account of an exploring expedition in New Guinea, conducted by Mr. Theodore Bevan in the steamer *Victory*. Another Australian paper, the *Daily Telegraph* of July 9, gives, with the map which we reproduce, a more detailed narrative, compiled from Mr. Bevan's notes. From this narrative we take the following passages:—

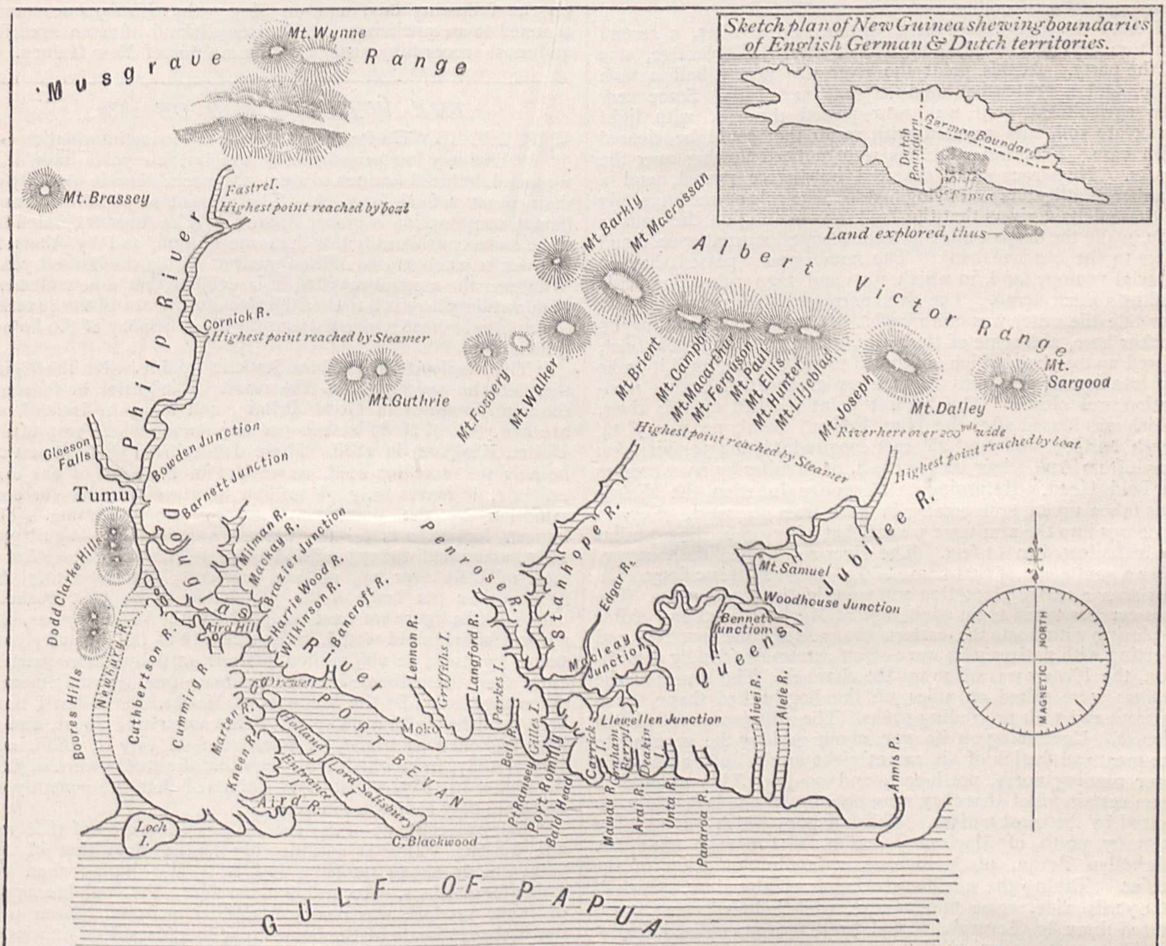
The *Victory* left Thursday Island at 5.30 a.m. of Thursday, March 17, and was headed for Cape Blackwood at the mouth of the Aird River, New Guinea, and distant 220 miles. On the following Saturday, early in the morning, the distant mountains of Papua were sighted, and at 6 o'clock Cape Blackwood was seen. Shaping a course after passing inside the cape to the north of Entrance Island and steering past it, the party found that the River Aird narrowed to about 200 yards, and after steaming from Entrance Island a distance of 5 miles, about 4 p.m. they came to a broad but seemingly shallow stream running into Deception Bay. (Deception Bay is the open space shown on the map between Cape Blackwood and Bald Head.) . . . It was found that the country between Deception Bay and the Aird River was made up of islands instead of being mainland as charted by Blackwood. Further, from a great number of water-ways and river openings on every side, it became evident that this was nothing less than the delta of a large fresh-water river, whose source was in the mountains seen from the coast. Steaming up this river, leaving alluvial scrub-covered islands to the left, and passing broad streams eachover half a mile wide on the right, the party found that deep water was carried to an important junction (named after Mr. John Brazier, of the Australian Museum) right under and to the south-east of Aird Hills. Here the river threw off two branches, one skirting the hills to the south and the other bearing north by east. Brazier Junction was found to be distant, as the crow flies, 30 miles from Cape Blackwood. . . . A portion of the party proceeded in the whale-boat for a distance in a north-westerly direction of about 6 miles, when to their surprise a wide branch of the river was opened up north by west, two important openings towards the south-west being also seen and named after Mr. Cuthbertson and Mr. Cosmo Newbery. It was becoming more and more evident that the main stream of a delta in a large fresh-water river had been reached, the southerly-running channels being divisions, and the Cuthbertson and Newbery Rivers probably discharging their vast volumes of water into Prince George's Inlet several miles westward of Cape Blackwood. This main stream was explored for some 5 miles, the depth being from 2 to 7 fathoms. The country around was of alluvial formation, and scarcely above the level of the river, but thickly covered with virgin forest, the trees reaching a height of 150 feet, and crusted with mosses, fungi, creepers, and orchids in tropical luxuriance. A magnificent view was obtained at one part of tier upon tier of ranges of hills to the northward, and behind these blue mountain peaks of from 7000 to 8000 feet in altitude, and from 40 to 50 miles distant. The river itself in the various branches looked like an immense lake studded with islands. This main channel the steamer proceeded up on the day following, and a second range of low palm-clad hills observed in front on the previous day proved to be the head of the delta. This was named after Mr. J. V. S. Barnett, of Cooktown, Queensland. This spot, as the crow flies, was 45 miles from Cape Blackwood, and only now could it be properly stated that *terra firma* had been reached, for south of them the soil was alluvial, being brought down from the mountains by this great stream, the volcanic cones of Aird Hills, rising to a height of 1620 feet to the south-east, being the solitary exception in these miles of dead-level, scrub-covered, deltaic alluvial flats. North of Barnett's Junction the river flowed between compact banks, through gradually rising country, and with an exclusive fresh-water current.

On March 25, after proceeding up the river a few miles, a third series of palm-topped conical hills were seen, and on the summit were two of their native houses, being about 200 feet in length. It was soon evident that the strange apparition of the steamer gliding into these fastnesses was visible from the shore, as the mellow sound of the conch shell was heard, warning the inhabitants of the scattered village of danger. Slowly the steamer approached, and when abreast of the village and opposite a creek some canoes full of savages were seen scuttling up the place in abject terror. The river now gradually widened out, and two large tributaries, running one from the north-west and the other from the north-east, were seen. This junction was observed to be in latitude 7° 11', and 144° east longitude. . . . The junction of these rivers was named after Mr. V. R. Bowden, of Thursday Island, the north-west and north-east branches being named after Messrs. Burns and Robert Philp, while the great river running from Bowden Junction into Deception Bay, a distance of over 60 miles, was called after the Hon. John Douglas.

The steamer was taken cautiously up Burns River, the north-west branch, and a splendid view of near mountain ranges was obtained, and apparently a splendid spot to explore. . . . Seven miles up the river an anchorage was come to, the river being over 300 yards wide, and the soundings being from 2 to 6 fathoms. The scenery was picturesque in the extreme. Hills of from 600 to 1000 feet, clothed with verdure, came down to the water's edge. There were cedars, oaks, eucalypti, fig-trees, acacias, pines, palms, and tree-ferns. Feathery bamboos, ferns and varied flora adorned the river banks. Butterflies of gaudy hue, and birds of the brightest plumage, flutter in and out amongst the trees and shrubs. The water was placid and in the deepest recesses of the gorge-like ranges was sombre and cold. . . .

A few miles further up the river a small rapid was passed, and it was then found that there was a break, one arm apparently running in a northerly direction towards ranges about 4 miles distant, and from 2000 to 3000 feet high, and the other arm stretching easterly towards high distant ranges, which closed in the horizon in that direction also, but they appeared to be about 25 miles off. This junction was named after the *Victory*, but the steamer could not pass it to any distance. The highest point reached by the steamer was ascertained to be in south latitude 6° 51′, and east longitude 144° 8′, that is to say 65 miles in a straight course from Cape Blackwood, or nearly 90 miles by river courses. This was on March 31.

A boat party was formed of eleven, and a week's provisions put in, but progress was slow, owing to the strong currents, the rapids, and the heavy rain that now came on in the evening. . . . The highest position inland reached by the whale-boat was within 25 miles of the German boundary, or 80 miles as the crow flies south-by-west of Cape Blackwood, and over 100



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miles by river courses. This was in south latitude 6° 39′, and east longitude 144° 11′. It appeared to Mr. Bevan that the natural boundary or water-parting between the river systems of the two territories might be found to exist a few miles to the north of the present German boundary. . . . The nature of the coast for several miles to the westward was now known, and it remained [after return to Deception Bay] to continue explorations to the eastward, and also to settle the point as to whether from so far in the heart of Deception Bay there existed a deep water channel leading out into the Gulf of Papua. Mr. Bevan decided to test this question. Although there were the river openings between them and Bald Head, it was unlikely that there would be room for any considerable river between the newly-discovered Douglas River and the large river of which it had been for years reported that the five openings east of Bald Head were separate mouths. Mr. Bevan first proceeded to Motu Motu, situated at the mouth of the Williams River on the easternmost boundary of the gulf, and 100 miles distant, in order to send off despatches. A start was made from Motu Motu on Monday, April 11, and after calling at Karama, Silo, Namai, and Vailalla, they anchored off Orokolo, in rather dirty weather. On April 14 the steamer was within a few miles of the Alele River, or first of the five openings east of Bald Head, reported by the natives as leading into one large river. Upon superficially examining the entrances to these five rivers, namely, Alele, Aivei, Panaroa, Unta, and Arai, no safe channel for the steamer could be found, owing to the heavy break on each bar. Off the next opening, or Marwau River, the same conditions were experienced, and there now remained but the wide entrance marked on the Admiralty chart. Towards this opening the steamer was steered, and carefully proceeded in with a $2\frac{1}{2}$ fathoms channel at low water, leading half a mile to the west of Bald

Head, an anchorage being found 2 miles within in 15 feet of sheltered water. Point Ramsay (named by Mr. Bevan) was 3 miles to westward, over an unbroken stretch of water, which also ran far inland to the north. This was an important discovery, as no ship had before been within this opening, and the *Victory* had again passed the confines of the known. In a little bight under Bald Head a village was discovered partly hidden and sheltered by a grove of cocoa-nut trees. Canoes with natives came off, and though shy at first, they afterwards came near. . . . The anchorage was left at 7.45 a.m., and 2½ fathoms deep was taken into a channel 5 fathoms in depth midway between Bald Head and Point Ramsay. For over 8 miles, with a depth of from 5 to 9 fathoms, the vessel proceeded until an important junction was reached. Here land traversed the horizon, and broad arms coming in from north-west to north-east joined the river. This junction was named after the Hon. W. Macleay, of Sydney, and the sheet of water so far traversed from Bald Head was named Port Romilly.

Round the point, and at a distance of 4 miles, a second junction was met with, and named after J. Beveridge, one of the party. At this point the river was nearly half a mile wide, and an extensive mud-flat was met with. Some very fair agricultural land was now passed through, with light chocolate soil, and covered with scrub that could be cleared with ease. Freshwater springs were noticed flowing over the banks. Numerous small deserted huts were passed, and a number of alligators and flying foxes. The rule seemed to apply in these deltaic rivers that the land was making on the convex side, while the deepest channel and strongest current were found close to the concave bank. The country now passed through alluvial swampy land, in which nipa and sago palms flourished amidst a thick scrub. The river narrowed to 60 yards, and at low tide the water was quite fresh. It was found necessary to anchor here, and some of the party, getting into the whale-boat, rowed up the river, which continued to get narrow, until it broke up into several deep but very narrow creeks, and further navigation was closed. The highest point reached up this river, which was named after the Hon. Edward Stanhope, was 7° 14′ south latitude, and 144° 28′ east longitude, being 34 miles due north from Arai River on the coast, or 40 miles by river courses to Bald Head. Returning to Beveridge Junction, the *Victory* was taken up an arm coming in here from the west. Several openings into the arm were passed, but after proceeding 7 miles up it shallowed to 11 feet. The river was named the Penrose, after a gentleman of that name of Yulgilbar, in this colony. On this river a native plantation and some natives were seen. The steamer was taken to an anchorage at Macleay Junction. After exploring with boats the eastern channels of this junction, and meeting with natives who were of an extremely friendly disposition, the *Victory* was taken up the channel. The houses of the natives were raised on piles of the hog-backed shape, open in front and with protruding peaks. The village was called Piri Evorra. Continuing on its way, about midday the steamer, to the great satisfaction of all, ran at right angles into a fine new river running north, north-east, and south. This seemed to form certain proof that they were now in the one large river reported by the coast natives. This junction, which was 11 miles west by north of Macleay Junction, was named after Dr. Llewellyn Bevan, of Melbourne, a family connexion of the leader. Taking the north-east branch of the river, which is 300 yards wide, some fine-looking, well-timbered country was passed through. Several deserted dwellings were noticed. After passing several miles up this splendid river another junction was met with, where a broad stream over half a mile in length came in from the easterly direction, and bifurcated into the channel, and a wide stream flowing south-south-westerly, with a steady fresh-water current flowing seaward. This junction was named the Bennett Junction after a friend. Three miles further up, and still another junction was met with, named after Mr. William Woodhouse, of Sydney. This proved to be the head of the delta of the great fresh-water river up which they had come, and which was named the Queen's Jubilee River. At this point the river again bifurcated, throwing off one main branch half a mile wide running down to Bennett Junction, and the other flowing easterly and southerly. Past Woodhouse Junction the river maintained its width of fully half a mile, and a range of hills 2000 feet high, a few miles distant, was named after Sir Saul Samuel. Mountain peaks of great altitude were visible some 40 miles to the north. Still proceeding up the river, a rapid some miles further on was passed, and soon afterwards it was found necessary to stop, but for one day over 30 miles had been travelled. The highest position reached was south latitude 7° 18′, and east longitude 144° 59½′, and distant 45 miles from Bald Head, and over 100 miles by the remarkably tortuous courses. As the river had now become unsafe, and only two days' coal were left for river work, it was found necessary to return to Bennett's Junction, from which it was hoped that the broad channel leading to the sea would be taken; but the master of the *Victory* demurred to this step, owing to the strong current running. The same objection had to be taken to the opposite, the southerly stream, at Llewellyn's Junction. The course was therefore taken by the one whereby the *Victory* had been brought in, and on Thursday, April 28, Bald Head was passed through again, and after putting in at Orokolo, a course was steered for Motu Motu, which was reached shortly before noon on the following day. York Island was reached on May 1, and Thursday Island on the following day, and on May 3 the *Victory* once more steamed to an anchorage at Thursday Island after an eventful and most successful journey into the interior of New Guinea.

THE WHEAT CROP OF 1887.

SIR J. B. LAWES forwards to us the following information:—

"The very low prices during the last few years have, it is supposed, induced farmers to use a not inconsiderable quantity of their wheat as food for stock. The amount so withdrawn from human consumption is quite unknown. It has been estimated by some to be considerably less than one million, and by others to be even as much as two million quarters within the harvest year. Whatever the amount may be, it is evident that a new element of uncertainty is thus introduced into our estimates of the quantity of imported wheat required to supply the deficiency of the home-grown crop.

"The 'Agricultural Produce Statistics' published at the beginning of the year give, as the result of inquiries in fourteen thousand parishes in Great Britain, and many in Ireland, an average yield of 26·89 bushels per acre for the wheat crop of the United Kingdom in 1886. If we deduct from this amount 2¼ bushels per acre for seed, as we did in the case of our own estimate, it leaves only 7¼ million quarters available for consumption by the population and for stock feeding. The imports less exports for the harvest year ending August 31, 1887, amounted to 17¼ million quarters, making altogether a total of little over 24½ million quarters. But assuming the consumption per head of the population to be 5·65 bushels, which is the figure we have adopted for the last ten years, the amount so required would, independently of the quantity consumed by stock, be 26½ million quarters, or two million quarters more than the estimated available home produce and imports taken together. By the kindness of Messrs. Beerbohm I have been furnished with a statement of the amount of wheat, and of flour reckoned as wheat, in warehouse on July 1, 1886, and July 1, 1887, from which it appears that the stocks were slightly the higher in 1887, whilst it is estimated that subsequently to that date they somewhat increased.

"Our own estimate of the yield of the wheat crop of 1886 was 29¼ bushels. This is considerably higher than that of the Government above quoted; and it is also higher than the estimates of others. According to our figure, the available supply of home produce was nearly 8 million quarters. Even with our higher estimate of the home crop, there is still a deficiency in the imports for the estimated requirements for human consumption, to say nothing of the amount consumed by stock. The evidence so far would thus seem to suggest the question whether there has not been some decline in the consumption per head of the population. At the same time it should be stated that if we take our own estimates of the available home produce and the recorded imports for the whole period of the eleven harvest years 1876–77 to 1886–87 inclusive, for which we have adopted a consumption of 5·65 bushels per head, the result shows precisely that amount available, if no allowance be made for consumption by stock. It is obviously desirable, however, that those who are engaged in forming the estimates of the yield of the wheat crop should also endeavour to ascertain the facts as to the quantity of wheat consumed by stock."

Sir John Lawes next exhibits tables proving his estimate as to the average yield of wheat at Rothamsted, and explains the peculiarities of the late season with regard to the growth of wheat.

He continues as follows:—"The Rothamsted result of 28⅝ bushels, which more probably under- than overrates the crop of the country, if calculated upon the slightly increased area this year, namely, 2,383,584 acres, gives an aggregate produce for the United Kingdom of 8,454,275 quarters. Hitherto we have always deducted 2¼ bushels per acre for seed, but this is supposed to be too high an average at the present time, and if we deduct only 2 bushels, there remain 7,858,379, or rather less than 8 million quarters available for consumption. Still estimating the consumption per head of the population at 5·65 bushels, the requirement for the harvest year would be 26,419,940, or nearly 26½ million quarters, of which about 18½ million quarters would have to be supplied by stocks and imports.

"For some reason the imports of wheat have been below the estimated requirements for the last two years. Whether, or to what extent, this is due to previous accumulations, to the home crops having been underrated, or to a reduction in the consumption of bread and flour, there is not sufficient evidence to decide conclusively. If there has been a reduced consumption, the question arises whether there has been an increased consumption of other foods. During the last few years there has been some increase in the number of both cows and other cattle kept, but there has upon the whole been a reduction in the number of both sheep and pigs. In fact, the records, neither of the home production, nor of the imports, of animal foods, afford evidence of any material increase in the consumption per head of such foods.

"Further, a careful examination of the amounts of the imports of other articles used as human food shows in the aggregate a reduction rather than an increase in proportion to the population. In such articles as rice and potatoes, for example, which would to some extent substitute wheat, the decline in the imports is very marked. Thus, whilst during the five years 1877–81, the average annual imports of potatoes amounted to 395,277 tons, during the five years 1882–86 they amounted to only 156,017 tons, or to considerably less than one-half. Nor is it probable that the amount of maize flour used has at all materially affected the consumption of wheat. The indication would thus seem to be, therefore, that if the consumption of wheat has really declined, either the total consumption of food per head of the population has also declined, or that the deficiency in the wheat imports has been compensated by increased supplies of home-grown foods. So far as potatoes are concerned, however, the 'Agricultural Produce Statistics' show a decline in area, in produce per acre, and in aggregate produce, both in 1885 and in 1886 compared with 1884. On the other hand, there has, notwithstanding an increase in the imports of other vegetables, been a considerable increase in the area devoted to market gardening during the last few years, and also an increase in the area of allotment gardens. It would obviously be a ground of satisfaction should further information and consideration show that, notwithstanding the very low prices of grain, there has been a larger consumption of some other home-produced foods.

"Whilst it is obviously of importance to the grower that his wheat crop should yield well, it has ceased to be a question of any interest to the consumer whether the yield of the home crop is a few bushels per acre more or less. Nor does such a difference, on our much reduced area, at all materially affect the supply from foreign sources. During the eight harvest years 1852-53 to 1859-60, which were the first of our estimates of the home wheat crop, nearly three-fourths of the aggregate amount consumed was of home growth, and little more than one-fourth was derived from foreign sources; but during the eight years 1878–79 to 1885–86 little more than one-third has been provided by the home crop, and nearly two-thirds by imports; and were it not for the value of the straw for bedding purposes it is probable that the reduction in the area under the crop would have been even greater than has actually been the case.

"Although greater facilities for acquiring land have been afforded by the Acts of Parliament recently passed, there is not much probability that the result will be an increase in the area under wheat, or other grain crops; or in fact that tillage on a small scale will successfully compete with arable farming as at present practised. Nor is it likely that there will be any permanent extension of peasant holdings of pasture land, excepting in localities where the soil and climate are specially favourable for permanent grass. But garden allotments, as distinguished from peasant holdings or from farm allotments, are of very great advantage to the masses of the population, and will no doubt continue to extend as they have done largely during the last quarter of a century."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

King's College, London.—A new laboratory has been fitted up in the College. It is provided with a collection of pathological material, biological, histological, and chemical apparatus, and is intended to afford every facility for obtaining a practical knowledge of bacteriology, and for prosecuting original research in all matters relating to human and comparative micro-pathology.

The laboratory is open to all gentlemen, whether students of other departments of the College or not. The practical courses and lectures are specially intended for medical officers of health, veterinary surgeons, and analysts.

A certificate of attendance will be granted to each member of these courses.

The winter course of lectures with practical work will commence on November 1. There will be about fifteen lectures, and the practical course will last for thirty days. The lectures will be delivered on Mondays, Tuesdays, Thursdays, and Fridays, at 10 a.m.

They will be illustrated with diagrams and typical preparations and followed by practical work in the laboratory for the rest of the day.

Admission will be permitted to the lectures without the practical work.

In the case of medical men in practice, medical officers, and veterinary surgeons of the army, and others whose duties may prevent their attending the laboratory daily, special arrangements will be made for extending the days of attendance over a longer period.

For further particulars apply to Prof. Crookshank, King's College, London, or to the Secretary, J. W. Cunningham.

SOCIETIES AND ACADEMIES.

Liverpool.

Astronomical Society, October 10.—Mr. W. F. Denning, of Bristol, President, in the chair.—This was the first meeting of the seventh session, and sixty-one candidates were proposed as members.—In his opening address the President referred to the last volume of their Journal as exhibiting the varied and attractive character of the work in which the members had been engaged. The angular measurements of fifty binary stars had been completed, and a valuable series of illustrated articles on lunar objects had been published. The remarkable dark patches in the "crape" ring of Saturn were observed and described by members at Bedford, and Louvain in Belgium. There had been a wide-felt regret that the objects of the Society's Eclipse Expedition of August 19 had been defeated by cloudy weather. Observations of Jupiter had been reported, and the increase in the rotation-period of his red spot fully verified. The meteoric section had made considerable progress. To the several members who had so practically aided the Society in its efforts to promote a knowledge of astronomy their warmest thanks were due. The ensuing session gave promise of increased activity, particularly in the stellar, planetary, and meteoric sections. The action of the American members in having so disinterestedly set aside national prejudices to enter into a bond of fellowship with English observers, had afforded great satisfaction, and must lead to a considerable extension in the Society's connexions and sphere of usefulness. The Society owed a debt of gratitude to Mr. W. H. Davies, F.R.A.S., the Hon. Secretary, for the untiring zeal which he had displayed in a very laborious office during several years. Undoubtedly a great future lay before the Liverpool Astronomical Society if its members continued their hitherto united policy. Individual interests and ambitions must be made subordinate to greater aims.

Paris.

Academy of Sciences, October 17.—M. Janssen in the chair.—Catalogue of the Paris Observatory, by M. Mouchez. The revision of Lalande's Catalogue, made in 1791–1800, and containing the positions of 47,390 stars, was begun in 1854 by Leverrier, continued in 1878 by M. Mouchez, and now completed far enough to begin the publication of the results. The first two volumes, which have just been issued, contain the 7245 stars comprised between oh. and 6h. of right ascension, for which 80,000 observations are recorded. A comparison of the results shows the surprising accuracy of Lalande's observations made with instruments which would now be regarded as very defective.—On the formulas of dimensions in electricity, and on their physical significance, by M. G. Lippmann. Some of these formulas give the idea of a corresponding physical interpretation. But it is shown that no electric magnitude appears susceptible of such interpretation, except where the dimensions may be reduced to those of time, certain electric phenomena having a duration capable of being calculated.—Researches on drainage, by M. Berthelot. Numerous experiments made at Meudon in connection with the study of nitrogen in vegetable soil lead to the general conclusion that the drainage of rain-water carries off a much larger quantity of nitrogen than that supplied to the soil by the atmosphere, and especially by the rain-water itself. This result is destined profoundly to modify the views hitherto accepted regarding the conditions of natural vegetation and of husbandry.—Duality of the brain and of the spinal marrow, by M. Brown-Séquard. It is shown that anæsthesia, hyperæsthesia, paralysis, and various phases of hypothermia and hyperthermia, due to organic lesions of the cerebro-spinal centre, may be transferred from one side of the body to the other. In a word, the author undertakes to establish as the result of a prolonged series of crucial experiments that, contrary to the generally received opinion, each half of the encephalon and of the spinal marrow may equally and independently serve for all the functions of the two halves of these nervous centres. The anæsthesia and analogous affections caused by an organic lesion of the nervous centres are transferred to the opposite side under the influence of a second lesion of those centres; hence it follows that such manifestations are not necessarily effects of the destruction of certain nervous elements endowed with certain functions, but may be the results of purely dynamic actions exercised at a distance by the irritation caused by the lesion. In the same way one half of the encephalon may serve as the seat of the voluntary motions and vaso-motor actions for either half of the body; and so with the spinal marrow, at least so far as concerns sensibility and the vaso-motor actions.—Remarks accompanying the presentation of the second volume of the "Compendium Floræ Atlanticæ, &c.," (Flora of Algeria, Tunis, Morocco), by M. E. Cosson. This volume contains a supplement to the already published notice on the botanical explorations in Mauritania, together with a detailed description of the families, genera, and species from the Ranunculaceæ to the Cruciferæ inclusive.—Observations of Peters's new planet, 270, made at the Paris Observatory (equatorial of the West Tower), by M. G. Bigourdan. The observations extend over the period from October 14 to 16. On the 15th the planet was of the 10·5 magnitude.—A mechanical and automatic registering apparatus of signals transmitted by telegraph and by optical projectors, by M. E. Ducretet. The apparatus here described and illustrated has the advantage over others in general use of automatically recording all messages for the purposes of reference in case of doubt or error occurring in the transmission of signals. It is equally available for ordinary telegraphic service, and for optical, military, and other systems.—Isoclinous magnetic curves, second memoir, by M. C. Decharme. This paper serves as a supplement to the author's previous communication on the isogonous magnetic curves relative to the declination. It deals specially with the isoclinous curves obtained with the dipping needle.—On a new mode of formation of the substituted safranines, by MM. Ph. Barbier and Léo Vignon. It was shown some years ago that the nitrous derivatives of the aromatic tertiary monamines, by acting on the primary monamines, give rise to certain colouring substances. Here are given the results of studies undertaken to determine the true character of these substances.—Researches on the bovine origin of scarlatina, by M. Picheney. The experiments here described tend to confirm the conclusion arrived at in England that scarlatina has its origin in the milk of diseased cows consumed especially by children.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Mattie's Secret: E. Desbeaux (Routledge).—Unfinished Worlds: S. H. Parkes (Hodder and Stoughton).—Bees and Bee-keeping, vol. ii. part 13: F. R. Cheshire (Gill).—British Dogs, No. 12: H. Dalziel (Gill).—Meteorologische Beobachtungen in Deutschland, 1885 (Hamburg).—Report on the Meteorology of India in 1885: H. F. Blanford (Calcutta).—Charts of the Bay of Bengal and Adjacent Sea North of the Equator, showing the Specific Gravity, Temperature, and Currents of the Sea Surface.—Charts of the Bay of Bengal and Adjacent Sea North of the Equator, showing the Mean Pressure, Winds, and Currents in each Month of the Year.—The Vegetable Lamb of Tartary: H. Lee (S. Low).—Austral Africa, 2 vols.: J. Mackenzie (S. Low.)—Report of the Meteorological Service of the Dominion of Canada for the Year ending December 31, 1884 (Ottawa).—The Encyclopædic Dictionary, vol. vi. part 2 (Cassell)—Handbuch der Oceanographie, Band ii.: Dr. Kummell (Engelhorn, Stuttgart).—Cow-Pox and Vaccinal Syphilis: C. Creighton (Cassell).—A Manual for Steam Users: M. P. Bale (Longmans).—Universal Phonography: W. Benson (Chapman and Hall).—Studies in some New Micro-Organisms obtained from Air: Grace C. Frankland and Percy F. Frankland (Trübner).—The Preservation of Fish: J. C. Ewart (Griffin).—Report of the Entomologist, C. V. Riley, for the Year 1886 (Washington).—Modern Lessons in Dynamical Geography and Topography.—Journal of the Chemical Society, October (Gurney and Jackson).—Journal of the Royal Microscopical Society, October (Williams and Norgate).—Indian Meteorological Memoirs, vol. iv. parts 2 and 3—Sitzungsbericht der K. Academie der Wissenschaften; Math.-Naturw. Classe, Mineralogie, Botanik, Zoologie, Geologie und Paläontologie, Jahrgang 1886, April to December (Wien).—Pnysiologie, Anatomie und Theoretischen Medicin, 1886, January to December.—Mathematik, Physik, Chemie, Mechanik, Meteorologie und Astronomie, 1886, January to December.—Journal of Physiology, vol. viii. No. 5 (Cambridge).—Annalen der Physik und Chemie, 1887, No. 10 (Barth, Leipzig).—Proceedings of the Bristol Naturalist's Society, vol. v. part 2 (Bristol).

CONTENTS.