THURSDAY, NOVEMBER 10, 1881

BALFOUR'S "COMPARATIVE EMBRYOLOGY"

A Treatise on Comparative Embryology. By Francis M. Balfour, LL.D., F.R.S., Fellow and Lecturer of Trinity College, Cambridge. Vol. II. (London: Macmillan and Co., 1881.)

MR. BALFOUR has brought out the second volume of his treatise with admirable punctuality, and zoologists will find it no less valuable than the first. Indeed it is in many ways more attractive than the earlier volume, on account of the fact that the developmental history of the Vertebrata is here dealt with, and has an interest for a large class of anatomists who are not addicted to the study of other organisms. Moreover, in treating of the Vertebrata (or Chordata, as he prefers to call them when the group is so extended as to comprise the Ascidians) Mr. Balfour has introduced a very considerable amount of original matter.

The structure of the Vertebrata is not only more complex than that of other animals, but it is also better known, and has been more minutely discussed by anatomists; and similarly the development of various Vertebrate types has been more keenly scrutinised than that of other forms. Amphioxus, the lamprey, the salmon, the dog-fish, the frog, toad, and newt, the turtle and lizard, the common fowl, the guinea-pig, rabbit, bat, and even man, have formed the subjects of numerous memoirs devoted to one or other of their phases of development. This has been going on for many years, in fact ever since Remak and Kölliker laid the foundations of what may be called "cellular embryology." The chick, the frog, and the rabbit have during this period enjoyed the services of a class of workers diffiering from those who have studied other animals. The latter have been naturalists interested in the study of embryology as throwing light on the affinities and origins of animal forms; the former have been distinctively medical men, who have sought in the minute study of the origin of the tissues of man and other Vertebrate animals indications which may be of service towards attaining the great desideratum of modern medicine, viz. a thorough knowledge of the physiology (*i.e.* the working of the mechanism) of man. Accordingly, from an early period the methods of the histological laboratory have been applied to the study of the Vertebrate embryo, and that by a large number of accomplished investigators, whilst it is only quite recently that the naturalists, as distinct from the medical men, have learnt to apply the same methods to the study of all organisms. There is at the present moment a movement from both sides and a fusion of the hitherto separate streams of "zoological" and "medical" embryology, which is marked as an epoch in the history of science by Mr. Balfour's treatise.

The medical histologist and physiologist has learnt that if he would comprehend the process of the cleavage of the egg and formation of the blastoderm and primitive organs he must not confine himself, as hitherto, to the limited area of comparison offered by the chick, the frog, and the rabbit; he must make common cause with the zoologist, and embrace the whole animal series in his view. He will, I cannot doubt, also soon openly acknowledge that the application of elaborate instruments of measurement to the nerves and muscles of dogs, rabbits, and frogs has furnished what knowledge it can in reference to man, and that if physiology is to move out of a barren path the whole evolutional series connected with man—the lowest as well as the highest—must be made the subject of experiment.

On the other side we find the field-naturalist—the lover of the forms and colours of animals—no longer content with a superficial study. To solve the problem which Mr. Darwin has succeeded in placing before him as the aim of his science, it is necessary that the minute structure of all animals—their cellular anatomy and embryology—shall be as accurately known as is that of the rabbit and frog to physiologists. Accordingly it is becoming more and more usual to find naturalists trained in the histological methods originated by the medical physiologists, and pursuing precisely the same inquiries as they do.

Since the germ-layer theory was shown to apply not exclusively to the Vertebrata, but, in a modified form, to the whole animal kingdom, embryology has become one body of doctrine equally significant for the practical ends of the medical man and for the speculative conclusions of the philosopher and naturalist. This fact is abundantly evident from Mr. Balfour's two volumes; in the earlier as in the present the chief aim is to trace the history of the units of structure known as cells from the parent egg-cell until the adult form is attained. The doctrine of cell-structure and that of evolution taken together serve to unite the interests of scattered and sometimes reciprocally contemptuous groups of scientific men—the physiologist and the naturalist will turn each with equal pleasure and profit to Mr. Balfour's treatise.

The embryology of the Chordata is first of all treated of, in the present volume, in zoological order. The terms Cephalochorda (for Amphioxus), Urochorda (for the Tunicata), and Craniata, which were proposed as divisions of Vertebrata in my "Notes on Embryology and Classification," are used, with some modification, by Mr. Balfour. Instead of Craniata the term Vertebrata is used, whilst in place of Vertebrata as formerly applied, the term Chordata is used. This change is open to objection, chiefly on the ground that it is more convenient to retain so well-known a term as Vertebrata for the more important group, and not to sink it in subordination to an unfamiliar term: also, as it seems to me, on the ground that the implication in both words "Chordata" and "Vertebrata," as used by Mr. Balfour, is delusive. All animals with a "chorda" would not necessarily take their place in the group of pharyngo-branchiate Chordata possessed of a tubular nervous axis and myelonic eyes, to which rather than Chordata the old name "Vertebrata" is appropriate—the Tunicates having been assimilated by the old-established group in the course of a natural process of the growth of knowledge.

The defence of the limitation of the term Vertebrata to the Craniate Vertebrates on the ground that they alone possess "vertebræ," raises the whole question of what we are to understand in the widest sense by the words "vertebræ" and "vertebrate." It seems to me to be difficult to construct a definition of either of these words

which will apply to structures present in the Lampreys, Sturgeons, Chimæra, and Dipnoi, and will not apply to structures present in Amphioxus. Gegenbaur's conception of the inapplicability of the term Vertebrata to forms devoid of myotomes as are the Tunicata, is, it seems, more reasonable. But even this objection is removed by the fact that in the tail of some Ascidian larvæ, and in Appendicularia, there are indications of segmentation of the muscular tissue.

However that may be, Mr. Balfour's account of the developmental phenomena exhibited by the various groups is of the greatest value, because it possesses three characteristics which also marked his first volume: it is complete as an epitome of all the very numerous and important contributions to the subject due to the Continental and English embryologists who have written so abundantly of late years; it contains a large amount of the author's original unpublished observations; and, lastly, it is no mere catalogue of the opinions of this and that authority, but is a critical treatise in which without arrogance, but with argumentative skill, a definite view as to the significance of the phenomena described, even when these are obscure and difficult of interpretation, is put before the reader. This latter feature gives Mr. Balfour's writings a special value, as pointing out lines of research for future observers.

The chapter on the Elasmobranchii is chiefly based on the author's original researches, which were published as a monograph. He has been extending his observations to the Cyclostoma and Ganoidei during the period in which he was also engaged in the preparation of the two volumes of the present treatise. Valuable original drawings (Figs. 38, 39, 40, 43, 45, 46 and 48) of sections of embryos of *Petromyzon Planeri* are given, and a correspondingly original account of the developmental history. Similarly the Ganoids, Accipenser, and Lepidosteus are illustrated by original drawings prepared from embryos supplied to Mr. Balfour by Prof. Salensky and Prof. Agassiz. In discussing the Amphibia much use has been made of the excellent figures given by Prof. Götte in his great work on the development of *Bombinator igneus*, but here again Mr. Balfour is able to rely upon original observations upon the newt, carried out in his own laboratory by Messrs. Scott and Osborn.

The fact that Mr. Balfour does not give us in a precise form a history of the development of the common frog from stage to stage, is explained by the special nature of his treatise, which aims at putting forward the generalisations of embryology and dealing with the developmental phenomena of the whole range of animal forms rather than providing the commencing student with a few selected examples of growth from the egg. Much is said about the common frog in the chapter on Amphibia, and from the general statements which it contains, in addition to the statements definitely relating to the frog, a nearly complete answer can be obtained to all questions which suggest themselves in relation to the main features of development in that animal.

The Birds are treated next in order after the chapter on Amphibia, and necessarily the common fowl—on which Mr. Balfour published some years since, in conjunction with Dr. Foster, a separate work designed for the use of junior students—is the source from the study of which his facts are derived. In this chapter, and in that on the Mammals, Mr. Balfour discusses the views of Kölliker as to the origin of the mesoblast from the epiblast of the primitive streak, and other interesting points raised, since his earlier work, by the observations of Braun on parrots and ducks, and of Gasser on geese.

The chapter on Reptilia is remarkably short, owing to the fact that very few observations have been made on members of this class, and that in many important points they agree with birds. Original drawings relating to *Lacerta muralis* and *Chelone midas* illustrate this section.

In dealing with the Mammalia Mr. Balfour has to depend chiefly upon the recent researches of Ed. van Beneden and of Kölliker, and his critical power and fair dealing is shown in the way in which he treats the points of disagreement between those two admirable investigators. The main outlines of our knowledge of the later development of the Mammalian embryo and its fœtal appendages were laid down many years ago by Bischoff and by Kölliker; but Mr. Balfour has given a particularly interesting account of the various modifications of the structure of the placenta presented by different mammals, illustrating his statement with woodcuts from the works of Prof. Huxley and Prof. Turner. With regard to the evolution of the placenta and the phyletic connection of the several forms seen in different recent Mammalia, he has some important original suggestions to offer.

It is impossible to give any idea, in a review such as this, of the abundance of facts and the thoroughness of treatment to be met with in the portion of Mr. Balfour's book which we have just noticed. It deals with the groups of Vertebrata one by one, and with the hundreds of questions which the greater or less knowledge of the particular group so far in the possession of embryologists, brings into existence in endless variety. The general results of such a method of exposition cannot be summarised in a review.

But such summarising has been to a very considerable extent carried out by Mr. Balfour himself in the latter two-thirds of the present volume, which will be found the most readable, and in some respects the most important, part of the whole work. We have a chapter on the comparison of the formation of the germinal layers and of the early stages in the development of Vertebrates, one on the ancestral form of the Chordata, and one treating of the mode of origin and homologies of the germinal layers in animals generally and of larval forms, their nature, origin, and affinities. To these chapters succeed twelve entitled "Organogeny," which actually constitute a treatise on comparative anatomy, based upon embryological data, under the headings (1) epidermis and derivatives; (2) nervous system; (3) organs of vision; (4) auditory organs, olfactory organs, and sense organs of the lateral line; (5) the notochord, the vertebral column, the ribs, and the sternum; (6) the skull; (7) pectoral and pelvic girdles and the skeleton of the limbs; (8) the body cavity, the vascular system, and the vascular glands; (9) the muscular system; (10) excretory organs; (11) generative organs and genital ducts; (12) the alimentary canal and its appendages in the Chordata.

In these chapters many of the facts which have been previously detailed in that part of the work devoted to the treatment of group after group are again brought forward

and looked at from a new point of view in relation to the doctrine of evolution, and facts which did not find their way into the earlier portion of the work receive consideration. Especially in the chapters on organogeny we find the questions connected with the probable first origin and later modifications of the nervous system and of the organs of special sense dealt with so as to supplement the earlier zoological chapters. It is not possible to single out for special notice any one of the discussions which may thus be said to sum up and give the general results of Mr. Balfour's work. But among the more interesting, as dealing with burning questions, are those relating to the origin of the limbs of fishes (based upon the author's recent investigations), and the nature of the excretory organs found in the different groups of the animal kingdom. In reference to the latter point Mr. Balfour commences his discussion with a remark which may be taken as an example of the judicial style in which he handles such problems. He says, "although there is not a little to be said for holding all these organs to be derived from some common prototype, the attempt to establish definite homologies between them is beset with very great difficulties."

The present volume is illustrated by about four hundred woodcuts, and consists of more than six hundred pages of royal octavo size. The first volume was of very nearly the same size, and as copiously illustrated. Together they form a contribution to that science of Biology which our countryman, Charles Darwin, has refounded and reformed, of which English men of science may feel justly proud. No work of the kind exists in any foreign tongue, and probably no such work would have been undertaken had not Mr. Balfour given himself to the task. Translations of Mr. Balfour's book are at this moment in course of publication both in Germany and in France. The thoroughness with which he has carried out the revision and incorporation of a few more than a thousand scattered memoirs by contemporary writers, and the excellence of his critical remarks and original observations and drawings, are all the more remarkable when it is remembered that only three years have passed since the work was commenced, and that during that time Mr. Balfour has been actively engaged in lecturing and teaching in his laboratory at Cambridge, has published several original memoirs himself, and has superintended the production of as many more by his pupils.

The University of Glasgow has recently recognised the importance of Mr. Balfour's labours in embryology by conferring upon him the degree of LL.D. *honoris causâ*.

Cambridge men, and all who hope for the restoration of the English Universities to their legitimate place in the academic sisterhood of Europe, must feel proud of Mr. Balfour and the steadily working school of biologists which has risen around the Trinity Prælector on the banks of the Cam. The Cambridge biologists are now a power in the scientific progress of the country, and it is from Cambridge that the new men come to fill positions as teachers of biological science in the colleges of Manchester, Birmingham, Dublin, Eton, and elsewhere. Few persons, however, know the smallness of the share which the University of Cambridge, as such, has had in this admirable development, and how necessary it is, if the present condition of activity is to continue within its boundaries, that adequate arrangements shall be made in permanence for the maintenance of the laboratories and for the salaries of those who are at present gaining honour for the University without receiving from it any return.

E. RAY LANKESTER

PRIMITIVE INDUSTRY

Primitive Industry, or, Illustrations of the Handiwork in Stone, Bone, and Clay of the Native Races of the Northern Atlantic Seaboard of America. By Charles C. Abbott, M.D. (Salem, Mass.: George A. Bates, 1881.)

THIS work is a valuable contribution to our knowledge of American archæology. Dr. Abbott describes successively the principal types of stone, bone, and bronze antiquities, especially those of New Jersey. The work is illustrated by more than 400 woodcuts, and is divided into 33 chapters devoted to "Stone Axes; Celts; Chisels and Gouges; Grooved Hammers; Semilunar Knives; Chipped Flint Knives; Drills; Awls or Perforators; Scrapers; Slick Stones and Sinew Dressers; Mortars and Pestles; Pottery; Sheatite Food-Vessels; Pitted Stones; Chipped Flint Implements; Bone Implements; Agricultural Implements; Plummets; Net-sinkers; Spear-points and Arrow-heads; Flint Daggers; Grooved Stone Club-heads; Pipes; Discoidal Stones; Inscribed Stones; Ceremonial Objects; Bird-shaped Stones; Gorgets; Totems; Pendants and Trinkets; Copper Implements; Hand-hammers and Rubbing-stones; Shell Heaps; Flint Chips; Palæolithic Implements; the Antiquity and Origin of the Trenton Gravels."

The number of stone implements which have rewarded Dr. Abbott's industrious search is really surprising. In New Jersey alone he has amassed no less than 20,000 specimens.

"From the great number of stone axes," he says "already gathered, and that remain to be gathered, from the area of the State of New Jersey, it is clear that this form of weapon or implement, as the case may be, was in constant and universal use among the Delaware Indians. In some localities, of several square miles in extent, there have been found from three to five axes in every one hundred acres, and still others are occasionally brought to light by the plough. Allowing but one-half the smaller number to have been left lying in every one hundred acres of the State's area, when abandoned by the Indians, there would remain, for the benefit of archæologists, the enormous number of one hundred and twenty-five thousand stone axes."

Considering the great abundance of stone implements, the rarity of typical scrapers in the United States is an interesting fact. No doubt many of the stone implements were used as scrapers, but I have hardly seen any specimens from Eastern America of the true typical North European and Eskimo form. Some of those figured by Dr. Abbott, though they may have served as scrapers, certainly are not of this type; and although others may be so, for instance that represented by Fig. 107, p. 124, it is difficult to speak positively, because Dr. Abbott does not give sections of the implements, so that in many cases their true form is doubtful. We would suggest to him to supply this omission in subsequent editions of his work.

Perhaps the most characteristic of American types are

the "spades" or "hoes," "oval plates of flint flat on one side and slightly convex on the other, the outline being chipped to a sharp edge." These differ principally from the European implements, which most nearly approach them, in their greater thinness. It is possible that they may have been used for agricultural purposes, and some bear traces of use, such as digging in sandy soil would produce.

Fragments of pottery are very abundant in New Jersey, but "unbroken articles of earthenware are rarely met with."

"A large portion of the pottery made by the Indians, however, was not made from pure clay just as it came from the bed, but the clay-earths that overlie the others were utilised and made available by mixing with them quartz granules and pounded shell. Much of the pure clay, which in many places was accessible, would need far more manipulation than the Indian potters would care to give it, and as the mixture of clay and shell was simpler and would meet all their requirements, it was, very naturally, most frequently used. They nevertheless possessed the knowledge of successfully working in pure clay, as sherds are found so made, and their well-formed clay smoking pipes are a further proof of the fact."

The forms are generally simple, and the ornamentation rude. The patterns are almost, if not quite, invariably geometrical; and generally made either with a pointed stick or bone, with the thumb-nail, with a twisted cord, or by covering the vessel, of course when soft, with coarse cloth.

Copper implements are comparatively rare, and Dr. Abbott is disposed to think that they—

"Were never designed for use as weapons or implements, but were intended for display upon special occasions, as for instance in their various dances, when much ceremony was observed, and various objects were displayed that at other times remained hidden in the custody of their fortunate owners, or of the appointed keepers, if tribal property."

He is clearly of opinion that they were merely hammered into form and never cast. They are always of very simple form.

As already mentioned, in one county of New Jersey alone Dr. Abbott has gathered no less than 20,000 stone implements. No one implement or pattern is peculiar to any one district, though certain forms abound in particular localities.

"Although in no instance has any one pattern of arrow-head been found so characteristic of a given locality as are the argillite fish-spears of the alluvial deposits along the river, it has frequently been observed by collectors that some particular form occurred in considerable numbers in a locality of very limited area, as a field or other small plot of ground. In my own collecting tours I have frequently noticed this, and can recall now certain fields that appeared to have only leaf-shaped arrow-heads, and others where the triangular pattern was alone met with. Even this is noticeable with other forms of chipped implements, and local collectors report fields, or other spots of a few acres, where only scrapers are found. This localising of certain forms has been so frequently noticed that it cannot be considered as a mere chance occurrence, yet it is scarcely susceptible of any rational explanation."

Dr. Abbott is of opinion that the Eskimo occupied New Jersey long before the advent of the Red Indian. To this earlier race he especially ascribes the implements made of argillite, which he regards as much older than the rest. Altogether he has found 4400 implements of this material, 233 being well-made drills or perforators and scrapers, the others spear-points, fishing-spears, arrow-heads, and knife-like implements. They are altogether ruder than the implements of flint and other materials, but

"Although it is true of these implements that they are of more primitive forms, and therefore probably older than the objects made of quartz and jasper, the argument does not rest so much upon this greater simplicity, as upon their decomposed condition, their occurrence at greater depths in the undisturbed soil, the greater adaptability of the spears for fishing purposes, and the absence of all indications in the deeper soils, of the utilisation of the minerals habitually used by the later Indians."

"For these reasons," he continues (p. 463), "it is claimed that we find sufficient evidence in them of a pre-Indian people—believed to be the Eskimo—who, it is further claimed, are the direct descendants of that still older race, the fabricators of the Palæolithic implements of the River Drift."

To many minds the most interesting question raised by Dr. Abbott's work will be the evidence as to the antiquity of man in America. Certainly some of the implements which he has discovered seem to belong to palæolithic types. In some cases he assures us they have been found in association with remains of the mastodon, and he is satisfied that those found in the Trenton gravels must be coeval with the gravels themselves.

The work concludes with a memoir by Prof. Henry Carvill Lewis on the Antiquity and Origin of the Trenton Gravel Beds. Prof. Cook is of opinion that they are of glacial origin, and derived from floods caused by the melting of a great continental ice-sheet. Prof. Lewis, on the contrary, maintains that they are post-glacial—in fact, a true river gravel of comparatively recent age. It cannot, he maintains, be assigned to the glacial epoch, except by assuming that there have been no river gravels deposited since that time, an assumption which he regards as quite untenable. On the whole, he concludes that there is no evidence which would render it necessary to assign to those gravels, or of course to the implements found in them, an antiquity of more than 10,000 years.

SACRED MYTHS OF POLYNESIA

Die heilige Sage der Polynesier—Kosmogonie und Theogonie. Von Adolf Bastian. (Leipzig: Brockhaus, 1881.)

PROF. BASTIAN, on a late journey made to enrich the Ethnological Museum of Berlin, stayed a short time in New Zealand and the Sandwich Islands, and there gathered some interesting information as to native traditions, some not yet published, and some which have been neglected (if ever met with) by European students. The documents now printed in a small volume all strengthen the opinion which has for years been gaining ground among anthropologists as to the civilisation of the Polynesians. It is true that they were found in Capt. Cook's time living in a barbaric state, and their scanty clothing and want of metals led superficial observers even to class them as savages. But their beliefs and customs

show plain traces of descent from ancestors who in some way shared the higher culture of Asiatic nations. At Wellington Prof. Bastian found Mr. John White, who, as a skilled translator of Maori, worked for Sir George Grey in bringing out the "Polynesian Mythology," and has been engaged in the study of native lore ever since. He is about to publish the results of his long study with the aid of the Colonial Government, and we have here as a specimen one of those mystic Maori cosmogonies which make us fancy we are hearing some Buddhist or Gnostic philosopher pour out his dreamy metaphysics about the origin of things. Out of the Primal Night, says the Maori poet, there divided itself Nothing, then came Darkness, then Seeking, and Following, and then such stages as Conception of Thought, Spirit Life, Desire, Coming into Form, Breath of Life, Space. All this is of a piece with the native Polynesian poetry in Taylor's "New Zealand," and that lately published by Judge Fornander in Hawaii. The poem that begins with the time when there was no voice nor sound, no day nor night, may remind us of the famous hymn of the Rig Veda that begins "Nor aught nor naught existed." We find here the well-known chant of Taaroa, how in the emptiness of space, when there was no earth nor sky nor sea, Taaroa passing into new forms became the foundation of the rocks and the sand of the sea, and the land of Hawaii was born as his shell. Prof. Bastian well compares this with the Scandinavian poem in the Edda, how there was no sand nor sea nor salt waves, no earth nor sky above, till Bör's sons made the mighty Midgard—earth. He points out, as he has already done, the curious likeness between the Scandinavian story of the fishing up of the monstrous Midgard-snake, and the South Sea Island tale of Maui fishing up the island of New Zealand. Not less striking is such an analogy as the Polynesian Taaroa mating with his own energy in female form, like a Hindu god with his Sakti. The author may well ask, are these people, with such far echoes of Orphic, Chaldean, Buddhist philosophy, the simple playful children of nature on whom we look down as representing the lowest rungs in the ladder of development? In Hawaii the German anthropologist learnt much from King Kalakaua, who is thoroughly initiated in the religious ideas of his royal predecessors, who used to have the eyes of their enemies offered them by the high priest in the stone bowl which his majesty still keeps as a curiosity. Out of the royal library he produced a MS. temple-chant, written about the beginning of this century, containing a cosmogony, of which Prof. Bastian reproduces as much as he had time to have translated. It has real poetry in it, and as a piece of child-like philosophy it is not without interest in its enumeration of the orders of beings, the grubs and worms, the sea-eggs and mussels, the seaweed in the ocean watched by the grass on land, the cranes and the gulls at sea watched by the hawks on land, and so on with trees and other creatures, till at last the gods come into being, and man rises out of the night. For a specimen of barbaric science may be mentioned the Maori myth told to the author by Mr. Davis, how the Moon arose out of the ocean, and still keeps the traces of this marine origin in its phases, which follow the ebb and flow of the tide.

EDWARD B. TYLOR

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 ensure the appearance even of communications containing interesting and novel facts.*]

The Struggle of Parts in the Organism

ALTHOUGH I agree with the Duke of Argyll that the pages of NATURE are not adapted to a discussion on the general question of Theism, the letters which you this week publish leave me no alternative but that of entering upon the subject, so far at least as it seems desirable that I should now express my individual opinion on the points which your correspondents have raised.

My statement of what I conceive to be the position of the matter may best be rendered by answering first the questions which are put to me by Dr. Carpenter. He desires me to explain the "precise sense" which I attach to the phrase, "a general law whose operation is presumably competent to produce any set of phenomena," and proceeds in a most terse and lucid manner to expound the well-known and unquestionable truth that "in the *purely scientific* sense a 'law of nature' is nothing more than a general expression of a certain set of uniformities which the intellect of man discerns in the surrounding universe," &c. This is the only sense in which I have intended to use the term, and if my meaning has been obscured by speaking of a general law "producing" any set of phenomena, it is only because the idea of "a law of nature" as "any kind of *coercive* agency," or indeed anything other than "a generalised expression of facts," was so far from my mind that I perhaps too readily employed a convenient, though metaphorical,[1] mode of expression—just as one speaks of the sun rising, &c. In speaking then of Natural Selection as "competent to produce" certain phenomena I only meant that, given a certain set of activities and conditions supposed to be uniform, and the phenomena in question would occur, whether or not these activities and conditions are taken to be due to a disposing mind. So far, therefore, am I from maintaining "that there is anything in the *law* of Natural Selection that places it in a different category from every other," that my whole contention is exactly the reverse—namely, that the law of natural selection stands to certain observed phenomena of biology in just the same logical relation as, for instance, the law of gravitation stands to certain observed phenomena of astronomy. Indeed, it is just because I hold the laws of evolution to be so precisely identical in logical *status* with all other so-called laws of nature, that I see no better evidence of Design in "the adapted structures" of "the Human Hand" than I do in the adaptation, say, of a river to the bed which it has itself been the means of excavating.[2] In both cases I believe that physical causes have been at work (whether or not there have been metaphysical causes of a mental nature behind them), with the difference only that the one set are more complex and less obvious than the other. But in each case alike, if the physical causes are deemed adequate to furnish a scientific explanation of the effects, there is no residual effect to be carried over for explanation by any metaphysical theory of Design. Design, of course, there may be in both cases; I only maintain that if the laws of evolution are conceded to stand to the structure of an organism in the same logical relation as certain other natural laws stand to the structure of a river's bed, then, *ex hypothesi*, the one set of adaptations constitutes no *evidence* of Design different in kind from that furnished by the other.

This appears to be the point where my opinion has had the misfortune to be found at variance with that of the Duke of Argyll. For in his last letter he says that "there are in nature a few [? many, *vide infra*] cases of apparent adaptations and of

[1] *I.e.* "metaphorical" as investing a natural "law" with the signification of a natural "cause." A law of nature I take to mean a general proposition or formula which expresses the observed operation of certain physical causes, whether or not these are known. Therefore, although it is, strictly speaking, incorrect to say that "natural selection is a law competent to produce adaptations," in using such a form of expression one may be understood to mean "the sundry physical causes, whose joint operation is formulated by the law of natural selection, are competent to produce," &c.

[2] This illustration is borrowed from Mr. Wallace, who, in his "Natural Selection," elaborates it very instructively.

orderly arrangements of a very simple kind which do not necessarily suggest Mental Purpose. They may be the effect of what we call accident, or of the action of elementary laws under no guidance or direction. Inorganic phenomena furnish many examples of such arrangements," &c., the argument proceeding to the conclusion that "the writers of the last generation were perfectly right in resting the general Argument from Design on the separate instances of adaptation in which the mark of Mind is most signal and conspicuous"—*i.e.* in organic structures. Now until it is shown wherein we are justified in classifying natural laws under two such categories as "elementary laws under no guidance or direction," and laws whose "action" gives rise to "separate pieces of evidence pointing to the operations of special design"—until this is shown I must remain of the opinion that "Mr. Darwin's theory of Natural Selection" *does* "touch this argument" of scientific teleology. The distinction between two such sets of general laws is clearly not one that can be recognised by science, and if it is conceded that the theory of Natural Selection is competent to explain the proximate or physical causation of "structural adaptations," we have no more right to refer the latter to ultimate or metaphysical causes than we have so to refer "orderly arrangements of a very simple kind which do not necessarily suggest Mental Purpose." For if this concession is made it means that the one set of causes differs from the other only, as I have said, in being somewhat more complex in character and less obvious in operation.

Again, the Duke of Argyll says he is "not able to accept" the distinction which I drew between scientific and metaphysical teleology. The distinction nevertheless remains, and it seems to me so obvious that I must suppose the Duke has in some way failed to appreciate my meaning. However he says, "The fundamental proposition of all arguments from Design is simply this: that the exquisite adaptations to special ends which are conspicuous in organic nature are, and can only be, the work of physical forces when these are under the combination and direction and control of Mind." But this is not "the teaching of the great masters" whom Dr. Carpenter names in his letter.[1] To some of them, at any rate, such a needless restriction of the argument to special adaptations in "organic nature" seemed unwarrantable, and since Mr. Darwin has shown how these special adaptations may be proximately explained by the operation of certain physical causes, the tide of theistic opinion has more than ever turned towards a still more "fundamental proposition" of the argument from Design, viz. that the harmonious uniformity of Nature as a whole demands some one co-ordinating principle as its explanation. And when from this proposition it is argued that the principle in question must be of a psychical character, the argument belongs to the province of what I have called metaphysical teleology. This, indeed, is merely the "Cosmo-theology" of Baden-Powell, who saw very clearly the distinction which I have endeavoured to present, and while inveighing more heartily than I have done against "the narrow and unworthy form in which the reasoning has been too often conducted," maintained that the "fundamental proposition," "the very essence of the whole argument, is the invariable preservation of the principle of *order*," &c.

Lastly, I do not understand the Duke where he says that I am much mistaken if I "suppose that the present generation is satisfied with the purely materialistic explanations of adapted structures which are erroneously supposed to be the final result of Mr. Darwin's theory." I have not said anything to imply that I supposed these explanations to be "purely materialistic." As a matter of individual opinion I do not think that in themselves they are. I see plainly enough that they have reduced the "exquisite adaptations conspicuous in organic nature" to the same general category of physical causation as all other phenomena in the physical universe; but for this very reason, if for no other, I should fail to see that they can be "purely materialistic" in the sense of touching the transcendental or extra-scientific question of Theism.

Having thus stated my views at some length, I shall take no further part in this correspondence, unless it should appear that some further explanation is desirable.

GEORGE J. ROMANES

[1] Except, perhaps, Mill, who thought highly of this form of teleology. But he also thought that if Mr. Darwin's "remarkable speculation" should be established as a truth of science, it would seriously "touch" the argument, as showing that "creative forethought is not absolutely the only link by which the origin of the wonderful mechanism of the eye may be connected with the fact of sight," &c.

Prof. Stokes's Lectures on Solar Physics

THE subject of these lectures (NATURE, vol. xxiv. pp. 593, 613) related primarily to the sun, and I was concerned with certain magnetic or electrical phenomena which are observed at the earth's surface only in so far as they related to the elucidation of the physics of the sun. Accordingly these collateral subjects were treated only very briefly, and I did not attempt to give anything like a history of the discoveries which have been made in them, even as regards the portions which bear more immediately on the physics of the sun. Indeed in many cases I designedly refrained from mentioning names, lest the hearers should suppose that I was giving a history of the subject, and those whose names might not appear in the very imperfect notice which it would have been should feel aggrieved. When a phenomenon was well known I generally contented myself with referring to it as such. Thus, for example, in alluding to earth-currents I spoke of them as what the progress of telegraphy had made us "familiarly acquainted with"; I said nothing about their discovery by Mr. Barlow, as described in his important paper published in the *Philosophical Transactions* for 1849, though it was a paper I had studied in connection with the lectures. I hope this example may suffice to prevent any one whose name does not appear from feeling annoyed at the omission, and to prevent the readers of NATURE from taking my lectures for what they were not intended to be, namely, a complete history of the subject. I take this opportunity of referring to one passage in my second lecture (NATURE, p. 415, a little above the figure), where I say "we might not have tension enough to produce such a discharge [*i.e.* a flash of lightning], the resistance to the passage of electricity from one portion of the air to another, which at any rate would be comparatively dry compared with what we have in warm latitudes, would prevent it by itself alone." These words, without actually asserting, seem to imply that the resistance to such a discharge through moist air would be less than through dry. My attention has been called by a friend to the fact that it has been found by experiment that moist air insulates as well as dry. I have not met with experiments tending to show whether the resistance to a *disruptive* discharge is the same or not in the two. Be that as it may, it does not affect what follows; for we know as a fact that thunderstorms are absent in high latitudes.

Cambridge, November 8 G. G. STOKES

The Society of Arts Patent Bill

IT appears that "the draft of a Bill for the Amendment of the Patent Laws has been prepared by a committee of the Society of Arts, and is published by the Council of that Society for consideration."

From the printed bill so prepared and published the following extracts are made:—

Extract from the Proposed Patents for Inventions Bill.

Section 3. "An invention is deemed new for the purposes of this act if it has not been published or publicly used in the United Kingdom, the Channel Islands, or the Isle of Man within the thirty years immediately preceding the date of the application of a patent for it.

"5. A patent may be granted under this act for:—

"(*a*) Any manufacture or any product not being a natural product;

"(*b*) Any machine, or any means of producing any manufacture, product, or result;

"(*c*) Any process or method of producing any manufacture, product, or result;

"(*d*) Any part of a machine, means, process, or method of producing any manufacture, product, or result.

"8. *Commissioners of Patents and Examiners.*

"(1) There shall be a Board of Commissioners of Patents for Inventions, in this act referred to as the commissioners:—

"(2) At any time after the passing of this act Her Majesty may, by warrant under the Sign Manual, appoint three persons to be commissioners, of whom one shall be experienced in engineering, one shall be experienced in chemistry, and one shall be experienced in the law.

"9.—(1) The commissioners may from time to time after the passing of this act, subject to the approval of the Treasury, appoint such persons qualified by knowledge of manufactures or science or arts, as they see fit, to be Examiners of Patents.

"*Infringement of Patents.*

"57. An action or other proceeding for infringement of a patent shall not after the commencement of this act be commenced in any of Her Majesty's Courts of Justice in England.

"58. For the purposes of this act a person is deemed to infringe a patent if he copies altogether or in part the invention of a patentee with the view of effecting the same or a like object, and fails to establish any of the pleas allowed by this act in a proceeding for infringement.

"59.—(1) A patentee may complain of any infringement of his patent to the commissioners.

"(2) The complaint shall be heard and determined by the commissioner (other than the legal commissioner) who is best acquainted with the subject-matter of the complaint, assisted by a legal assessor to be appointed for the purpose by the commissioners.

"(3) An appeal shall lie from the decision of the tribunal thus constituted to the three commissioners, who shall hear the complaint *de novo*, and their decision shall be final.

"(4) The commissioner or commissioners sitting to hear any complaint may decide all questions of law and fact, &c.

"60. The pleas allowed by this act in a proceeding under this Act for infringement of a patent are—

"That the particular matters alleged to be infringed do not show sufficient invention to justify the grant of a patent, or are not new within the meaning of this act;

"That the patentee is not the true inventor of the invention, or of so much of it as is alleged to be infringed;

"That the matters complained of do not amount to infringement;

"That the claim of the patentee as respects the matters complained of is not stated with sufficient clearness;

"That the specification is, as respects the matters complained of, incomplete or misleading;

"That the patentee, as respects any matter complained of, withheld that which he knew to be a better description than that given in the specification."

. . . . . .

In commenting upon the above extracts it may be remarked that one main object of this bill appears to be to raise "*experts*" to the dignity and duties of the judicial bench. It is something quite new in the legal history of this country to make a man a judge because he has been frequently examined in court as a witness, and has shown considerable skill in baffling a hostile counsel.

The originality of such a proposal cannot be disputed, and accordingly the advocates of the present bill are justified in stating that it "provides for the trial of patent cases in an entirely new *manner*." What that manner is will be understood by referring to some clauses in the bill, the provisions of which are admirably non-legal in their phraseology.

By Section 57, "An action or other proceeding for infringement of a patent shall not, after the commencement of this act, be commenced" (in the only place where it can be brought, viz.) "in any of Her Majesty's courts of justice in England."

By Section 59, "A patentee may complain of any infringement of his patent to the commissioners."

Who then are to be the commissioners who are to stand in the place of the Lord Chancellor, the Master of the Rolls, and the law officers of the Crown, and who are to assume the functions of Judges of the High Court in ruthless disregard of the operation of the existing law?

By Section 8 they are to be three persons, "of whom one shall be *experienced* in engineering, one shall be *experienced* in chemistry, and one shall be *experienced* in the law." That is to say, they shall consist of two experts and a barrister.

To them the trial of all actions for the infringement of patents is to be relegated, but the proceeding is not to be called an action, it is to be "a complaint," and pleas only are to be raised by the defendant. It is here that the reformers, assisted by their barrister, show a wonderful capacity for disintegrating the law of patents.

They begin by defining the subject matter of a patent. This opens an opportunity for a display of strength, and they complacently remark that "at present the ancient definition of the Statute of Monopolies is in force, but, as a matter of fact, the question of subject matter depends wholly on the decision of the courts."

This is true, for we have from the period of James I., and especially since the invention of the steam-engine, a series of judgments which have enunciated with remarkable clearness and force the principles which should guide the courts in dealing with any future patent wherein it may be doubtful whether or not the thing patented is the proper subject for a patent right.

But instead of deciding any new case upon principle, our reformers give us a definition, or rather they give four definitions, the third of which is large enough to swallow all the rest, and would probably satisfy the most ardent inventor.

Hereafter the subject of a patent shall be

"*Any method of producing any result.*"

In spite of the protection afforded by the able Commissioners and their far-reaching staff of examiners, it may be doubted whether the public will feel quite safe in allowing monopolies to grow under the light of this definition. It may seem perhaps a little too general, it may include a few things more than the reformers have dreamed of.

Next, as to priority of invention:—

According to the Statute of Monopolies, patents may be granted for fourteen years for the "sole working or making of any manner of new manufacture within the realm to the *true and first inventor and inventors* of such manufactures which others at the time of making such letters patent shall not use," &c.

Hitherto a patentee must be the *first* inventor of the invention for which a patent is granted. Hereafter this distinction is abolished. "An invention is to be deemed *new* which has not been *published* or publicly used in the United Kingdom within thirty years immediately preceding the date of the application."

Lord Westbury has laid down "that the prior knowledge of an invention to avoid a patent must be such a knowledge as will enable the public to perceive the very discovery and to carry the invention into practice."

But inventions are now to be swept away by neglect and disuse. A process of de-publication is originated, whereby after thirty years neglect an invention may be deemed never to have been published, and the books wherein it has been described may be regarded as non-existent.

It has been a maxim of the law that when the public have once become possessed of an invention by lawful means, the right to use it can never be taken away from them. All this is done away with.

In what manner the promoters of this bill intend to work out their scheme of giving new birth to old inventions can hardly be understood from the above definition of a new invention, but the clause would appear to lead to endless confusion and uncertainty.

Next, as to infringement:—

By Section 58 "a person is deemed to infringe a patent if he copies altogether or in part the invention of a patentee with a view of effecting the same or a like object, and fails to establish any of the pleas allowed by this act in a proceeding for infringement."

The pleas are quoted in our extract from the bill, and a defendant may plead:—

"That the claim of the patentee as respects the matters complained of is not stated with sufficient clearness."

At present, as Lord Justice James has pointed out, there is nothing in the Statute of Monopolies or the patent law which says anything about claims. The legitimate object of a claim is the protection of the patentee, and a specification may be perfectly good without any claim at all. If there be a claim, the specification and claim are read together, and the claim must be construed with reference to the whole context of the specification.

According to the old practice a defendant would plead that the specification (whereof the claim, if there be one, forms a part) is insufficient.

According to the proposed bill the plea is to take the form:—That the *claim* is not stated with *sufficient* clearness. A plea to the sufficiency of clearness is somewhat embarrassing to a lawyer. Has it any meaning? and if so, what does it mean? The clearness which satisfied the patentee when he applied for his patent may not be sufficient to satisfy the commissioners when they are sitting in judgment. There may be some amount of clearness, but not enough. In the end, a patent may be wrecked on a mere verbal criticism, the very thing which the courts of law now set their faces against.

The infringement of a patent *only* takes place when a man *copies* the invention forming the subject-matter thereof. To limit an act of infringement in this way is absurd, and would

not be tolerated for an instant, as any patent lawyer would know.

As a matter of fact, there is a case pending which shows the risk of inventing new law. A company has brought an action for the infringement of a patent for making dynamite, the question being whether a man infringes a patent by acting as custom-house agent for admitting into this country a quantity of dynamite made abroad in infringement of an English patent. The Court of Appeal has given its judgment, and the case may go to the House of Lords. None of the six pleas enumerated in the draft bill will raise the question. And they will not raise another question which came up during the trial. The plaintiff company was formed to take over the dynamite patent from a prior company which then ceased to exist. The prior company assigned the patent to the plaintiffs with some very large words as to legal rights, and it became necessary to decide whether or not the second company could sue for infringements of the patent committed while the first company held it. The defence, that the right to sue for a tort is not assignable, could not have been raised under the proposed statutory pleas. Any plea which puts in issue the title of a complainant is inadmissible.

Lastly, as to the trial of a complaint of infringement :—

By Section 59 a complaint is to be heard in the first instance by the expert commissioner who is best acquainted with the subject matter. This judge is to be guided by a legal assessor, who will direct his mind into legal channels.

"From the decision of the tribunal thus constituted" (*sic*) an appeal will lie to the three commissioners, that is to say, to the original expert who has given his decision, to his brother expert, who is not experienced in the subject matter, and to the legal expert.

In other words, suppose the patent to be for a mechanical invention, and that we have three commissioners, A, B, C, of whom A is an engineer, B is a chemist, C is a lawyer.

A hears the case and gives his judgment ; B knows nothing of mechanics, and reviews A's judgment with the advantage of having A at his side to keep him in the right path according to A's views, while C acts as a sort of legal adviser, it being part of the scheme that there shall be no models, without which it can scarcely be hoped that B and C will ever get so far as to understand the invention.

This is the mode of trial which it is gravely proposed to substitute for the present inquiry in a court of law, with a right of appeal, first, to the Court of Appeal, and afterwards to the House of Lords.

Here ends one part of the new bill. The procedure in obtaining a patent can only be carried out if commissioners are appointed according to the provisions already discussed. This would appear to be too improbable to justify any further encroachment upon your space. LEX

"The Lepidoptera of Ceylon."

THE Colonial Government has recently presented to the library of this establishment Parts I. and II. of the work above named, for the publication of which it granted a large sum of public money. The origin of the book was the existence here at Peradeniya of a very fine series of original drawings made during a course of years by the well-known botanical draftsman in the employ of the Gardens—Mr. William de Alwis—under the careful supervision of my eminent predecessor Dr. Thwaites. The plates now published are copies of these figures (the originals are in the Colombo Museum), and to these, Mr. F. Moore has added brief technical descriptions. As a botanist it would be presumption in me to express an opinion as to the merit of the text of an entomological book. There are thirteen new genera in the first part and six in the second, but only three out of the nineteen contain any new species ; so at all events we get plenty of changes in the names of many long and well-known butterflies. But in the interests of scientific literature in general, I feel bound to enter a protest against the legend printed at the foot of every plate, "F. C. Moore, del. et lith.", as it is incorrect as to the facts. I have already stated by whom the figures were really drawn; it is however only fair to the unassuming Sinhalese artist to allow that as put on the stone and published they are very greatly inferior to the admirable originals. One would like to think that it was a consciousness of this that led Mr. F. C. Moore to substitute his own name for that of W. de Alwis. But however this may be, it is time that some explanation was given by him of what looks like very shabby treatment of one of the best and most deserving natural history artists of the East. HENRY TRIMEN

Royal Botanical Gardens, Peradeniya, Ceylon, October 10

An Alleged Diminution in the Size of Men's Heads

WHEN the hatter's note was brought before the Council of the Anthropological Institute, I supported its reception and publication ; my own observations have led me to the same conclusions. Setting aside for the moment the consideration of the authenticity of the statement—and I am not surprised that Prof. Flower should ask for more evidence—I would beg to call attention to the statistical results affecting infantine mortality, which are so well known to us in the statistical world. As we all know, it is a matter of congratulation that the rate of mortality in the periods from birth to two years, and from that to seven years, has much diminished in this country. This being so, the result is inevitable that many of the weaker infants that in a bygone day did not survive have now been saved ; and their survival means the survival of so many weaklings. It appears to me that this is going on in the United States and in many neighbouring parts of Europe. The question of degeneracy under sanitary influence is well worthy of attention and investigation. While on the one hand we see in the streets fewer cases of deformity and of squinting owing to orthopædic advances, there are many stunted individuals. The ears appear to me to be below the old standard in men and women. A well-formed ear was much more common in England than now. It also seems to me that the period of maturity in men (not puberty) is often later. The remark has been made that frigidity is more prevalent in women. It has come under my notice that the children of fine parents are often stunted, not belonging to the short races in the country, but being really stunted. We must always allow for a portion of the offspring belonging to the tall races, and a portion to the short races in the same family in England. My own belief is that the women are better than the men, and that when the effects of sanitary and medical improvement have become constant, that even the inferior women will exhibit a greater tendency to normal production. It is possible that the evil may be to some extent corrected by barrenness and frigidity. Looking back, I can find no effective cause in tight-lacing, as bad formerly as now, thicker or thinner hair since wigs, nor in wearing the hat.

32, St. George's Square, S.W. HYDE CLARKE

Sound-producing Ants

WITH reference to a remark of Mr. S. E. Peal's (NATURE, vol. xxiv. p. 484) to the effect that white ants emit sounds, but not in rhythm, I have to observe that I have frequently heard white ants emit sounds with the most perfect rhythm, when, in the years 1857–1860, I was engaged in the Geological Survey of Trichinopoly, &c. On several occasions it happened that my tent was pitched on a piece of ground infested with white ants, and it was the custom of my servants to spread a thin layer of straw beneath the *satrinji* or cotton carpet that was laid on the tent floor. Often, when sitting in the tent in the quiet of the evening, I have heard the white ants at work in the straw, emitting perfectly rhythmical waves of sound at intervals of about a second, or perhaps rather more. If they were disturbed by raising the *satrinji*, the sounds ceased : to be resumed however after a minute or two, when all was quiet again.

Simla, October 15 H. F. BLANFORD

Song of the Lizard

ANY one who has been in the South of Europe in the summer may have often heard a peculiar sound in the fields or amongst low herbage. The sound is like *wheet-t'wheet* repeated two or three times at short intervals. I have often been puzzled as to what animal it proceeded from, and should have supposed it to be some orthopterous insect, but that on getting to exactly where the sound had come from, it would again be heard at a distance of some five or six yards without having been seen. Last June, near Ajaccio, I believed I solved the puzzle. After the *whe t-t'wheet* a small lizard darted across some unusually bare ground, and, once again under cover, recommenced its song. Our great authority, Dr. Günther, is not aware of any true lizard having any vocal power (geckoes have a *tchet-tchet*—not often heard—are generally nocturnal, frequenting houses or old walls, occasionally hiding under stones during the day).

Perhaps the ability of some lizards to produce sounds such as I have here described may not be new to some of your readers.

1, Burlington Road, W., October 31 FRANCIS P. PASCOE

SEALS IN LAKE BAIKAL.—A. H. Keane wishes to know what authority there is for the statement made by E. Réclus ("Géographie Universelle," vi. 741) that seals outwardly resembling the *Phoca fœtida* of Spitzbergen are found in Lake Baikal; also what theories have been advanced to explain the presence of these Cetaceans in a freshwater lake over 1300 feet above sea-level.

NAPLES ZOOLOGICAL STATION.—For the terms on which permission can be obtained to work at the Naples Zoological Station, W. B. should write to Dr. Anton Dohrn, Stazione Zoologica, Naples.

MELAPTERURUS ELECTRICUS.—Keep it in an aquarium of fresh water, not too cold.

REV. J. F. T.—See the notice prefixed to our Correspondence Columns.

CHARLES W. HARDING.—You should communicate with the widow.

SEA FROTH

IN a letter written by my nephew, Mr. Ernest Gladstone of Aberdeen, describing the recent storms, he says: "When we got within a quarter of a mile of the sea we were astonished to see great flocks of foam, like snowballs, flying in all directions. A little further on we came to one of the large hollows in the links, and we saw a sight none of us had seen before; for the whole hollow, about 100 yards long and 50 broad, was one sea of slimy foam, of which a great part must have been about 10 feet deep. This was tossing up and down as if it were the sea itself. The waves of water broke far out at sea, but great rollers of foam kept rolling in towards the links, making it impossible to come near the sea without wading up to your waist in foam for nearly a quarter of a mile, and occasionally meeting a foam-wave up to your neck."

There is nothing unusual in this phenomenon, except the large scale upon which it took place. Almost every visitor to the seaside during rough weather must have observed the formation of a persistent sea froth, which is often carried great distances by the wind. The account, however, recalled to my memory some observations on the cause of the phenomenon which I made last year at Ilfracombe.

The white foam of a breaking wave, under ordinary circumstances, disappears almost as quickly as the small bubbles of entangled air can rise through the water and burst at the surface. It occurred to me that there must be something dissolved in the sea water which gave rise to the formation of the more persistent froth, and the broken and bruised sea-weed suggested itself to my mind as a probable source of such a substance. A quantity of it was therefore gathered, allowed to stand for several hours, till in fact it had run down to a liquid, and then filtered from the dirt and organic *débris* with which it was mixed. The clear water thus obtained gave a persistent froth, like that of beer, whenever it was shaken, and I subsequently found that it contained a considerable amount of organic matter. There was no distinct indication of anything albuminous.

In order to ascertain whether this property was due to broken sea-weed, two bottles were filled with ordinary sea water. Into one of these was put freshly-torn pieces of those kinds of fucus and other marine plants which were found growing between high and low water-mark, and in the other were placed strips of healthy laminaria freshly gathered from the lower zone. The bottles were violently shaken for a few minutes. The first gave a foam which quickly disappeared, while the second produced a froth which would remain more than twenty-four hours before all the bubbles broke. It may be observed in passing that this sea-froth, whether naturally or artificially prepared, becomes very iridescent on standing.

It seems fair to conclude, therefore, that the formation of this persistent froth is due to the destruction of the sea-weed—not of that which is tossed about by every tide, but of the laminaria which is uprooted and torn by the waves only when the violent agitation of the sea reaches a sufficient depth. J. H. GLADSTONE

OUR WINTER REFUGES—VENTNOR

IT is now upwards of half a century since Sir James Clark's classic work "On the Influence of Climate" in the prevention and cure of chronic diseases appeared, and among the more important results which followed its publication was the establishment of stations in this and other countries for meteorological observations, by which alone the climates of various sanatoria might be accurately compared. To Sir James is due to a great extent the merit of having placed the investigation of this important department of practical meteorology on a sound basis.

The late Dr. Martin of Ventnor was one of the most intelligent and active of the co-operating band of observers whose services were enlisted in the inquiry. A valuable series of observations was begun by him in the end of 1839, in establishing which Mr. Glaisher kindly gave his assistance and advice. The observations have since been carried on uninterruptedly, and they are evidently, particularly those of temperature and rainfall, of such a quality as quite to meet the objects aimed at. The results are presented and summarised in a just-published volume[1] by Dr. Whitehead with ability, in their bearings on the climatology of Ventnor.

The Isle of Wight occupies a high place as a favourable and commodious residence throughout the year for a large class of invalids, owing to the variety which it presents in point of elevation, soil, and aspect, and to the configuration of its hills and shores, which give distinctive climatic peculiarities to certain districts, notably to the Undercliff. These peculiarities are of no inconsiderable value in the treatment of those diseases which require a mild, equable temperature, a comparatively small rainfall, and protection from certain noxious winds.

The Undercliff extends for nearly seven miles from Bonchurch to Blackgang, with an average breadth of a third of a mile, and is completely sheltered from the north-east, north, north-west, and west winds of the Uppercliff—a range of lofty downs of chalk and sandstone which rise boldly behind the successive terraces in elevations varying from 400 to 600 feet. Since the Undercliff terminates in an unbroken perpendicular sea-cliff from 60 to 80 feet in height along its whole extent, the situation is not close or confined, but open and airy, and affords, besides, certain material advantages in the mitigation of sea fogs and low night temperatures. The broad belt of the Solent and Spithead separating the Isle of Wight from the mainland, and the position of the Undercliff in the extreme south of the island, considered with reference to the prevailing winds of the Channel, are also important factors in the climate of the district.

In more recent years several other meteorological stations have been established in other parts of the island and on the adjacent coast of Hampshire, from the observations of which a comparison may be made of the climatologies of this part of the South of England.

On an average of the last twenty-one years the annual rainfall of Ventnor was 30·00 inches, being all but identical with that of Osborne and Bournemouth. The amount rises successively at Hurst Castle, Ryde, and Newport, the rainfall at the last place being 34·20 inches,

[1] "The Climate of the Undercliff, Isle of Wight, as Deduced from Forty Years' Consecutive Meteorological Observations," by J. L. Whitehead, M.D.

or fully four inches in excess of Ventnor. While the rainfall of the comparatively low-lying coasts of the Isle of Wight and Hants is about 30·00 inches, the amount along the coast from Selsey Bill eastward as far as Folkestone is two inches less, but on the coast of Devon, from Lyme Regis to Start Point, it rises to from 33·0 to 37·6 inches—figures of some importance in their relations to the sanataria of these coasts.

One of the most interesting results disclosed by these forty years' observations is the successive gradual increase of the rainfall decade by decade, the means being respectively, beginning with the decade 1840-49, 25·72, 28·45, 29·16, and 31·11 inches. This feature of the rainfall holds also in several other districts of the United Kingdom ; whereas on the other hand other districts present a very different distribution during these forty years, that of some districts being just the reverse of Ventnor. The mean rainfall of Ventnor for the twenty years ending 1859 being 27·08 inches, and for the twenty years ending 1879 being 30·14 inches, points to the necessity there is that care be taken to employ the same terms of years in comparing the rainfall of different districts.

The mean temperature for the forty years is 51°·6 ; the coldest month being January, 41°·9, and the warmest August, 62°·7. As January may be taken to represent the coldest months of the year, or the season when the climate of the Undercliff affords the greatest advantages to invalids, the following comparison of its temperature with that of other places in the South of England may be stated :—It exceeds the temperature of Sidmouth by 0°·2 ; Bournemouth by 0°·6 ; Osborne by 1°·2 ; and Folkestone, Eastbourne, Brighton, and Clifton by 1°·7 ; but on the other hand its January temperature is lower than that of Torquay by 1°·1 ; the extreme south-west of Cornwall by 2°·6 ; and Scilly by 4°·4. In this connection it is to be noted, as already pointed out, that along the coast to eastward the rainfall is less, and the climate therefore somewhat dryer ; and to westward the rainfall is larger and the climate therefore wetter ; and this latter remark applies with increased force as respects all places to the westward of Prawle Point.

The climatic advantages of the Undercliff, due to its southern insular position and distance eastward from the Land's End, by which the force of the west-south-west winds are much weakened before arriving there, are perhaps most apparent on examining the columns of minimum night temperatures. In this remark we refer to the general teaching of the figures, which indicate a remarkable protection against the inroads of low temperatures, with their malignant influence as respects a large class of invalids ; and not to such singular temperature phenomena as the occurrence of 17°·0 on January 22 last, during the great snowstorm of that period, for if great or exclusive weight be given to such temperatures the winter climate of the Undercliff must yield to that of many insular situations in the north-west of Scotland.

As compared with London the mean temperature of the Undercliff is 2°·4 less in July, 0°·8 in August ; but in September it is 0°·7, and in October 2°·2 higher. In other words the heat of summer is greatly mitigated on the south shores of the Isle of Wight, and prolonged further into the autumn months, thus greatly extending the time during which invalids might sit out in the open air with impunity.

Dr. Whitehead's book is handsomely bound, carefully got up and printed, and the tables are introduced to the reader by a well-written and sensible preface. When the work, however, passes into a second edition, one or two improvements might be introduced. A table of monthly mean temperatures of the several years might be given similar to that of the rainfall on pp. 29, 30. In this edition no mean temperatures of the months are included, and to ascertain these the whole of the temperatures must be copied out from pp. 8 to 23, and the averages struck. The table of monthly barometric means requires careful revision, several of them showing transposed and inverted figures, while a few others require to be compared with the original observations from which they are calculated—transpositions and inversions of figures not being so readily seen in barometric as in thermometric and rainfall averages. The work, however, is an exceedingly valuable addition towards a correct knowledge of the climatologies of the South of England, which holds out to invalids the best winter refuges of the British Islands.

INTERNATIONAL GEOLOGICAL CONGRESS

THE second session of the International Geological Congress was recently held at Bologna, commencing on Monday, September 26. About 200 geologists were present, but only eight of them represented the English-speaking nations. These were : Prof. James Hall (representing the United States), Dr. T. Sterry Hunt (Canada), W. T. Blanford (Geological Survey of India), W. Topley (Geological Survey of England), Prof. T. McK. Hughes, J. A. Phillips, E. B. Tawney, and Col. Tabuteau.

The arrangements made for the Congress were admirable in every respect, thanks to the energy and forethought of Prof. Capellini and M. Giordano.

The first session of the Congress was held at Paris in 1878. At that meeting certain geologists were nominated to organise committees in each country to discuss and report upon the various questions requiring attention. These are classed in three main divisions : (1) the unification of geological nomenclature (of this committee Prof. Hughes was nominated president for England) ; (2) the unification of colours, signs, &c., employed in geological maps and sections (of this Prof. Ramsay was nominated president for England) ; (3) nomenclature of species ; on this subject no action has been taken in England. Prof. Hughes' committee has been for some time at work, and notices of its progress have at various times appeared in this journal. The Committee on Geological Maps was started in England much later, but a report of its work was read at the York meeting of the British Association. At that meeting the Association gave a grant of 25*l.* in aid of the proposed International Map of Europe.

Some preliminary meetings were held at Bologna on Sunday, September 25, but the real work of the week commenced next day, when the Congress was formally received by the Syndic and Municipality of Bologna. At the opening meeting the chair was occupied by M. Berti, Minister of Agriculture and Commerce, who had been deputed to represent the King. The chairman was supported by M. Q. Sella, honorary president, and M. Ed. Hebert, ex-president. The bureau was formed as follows :—President : Prof. Capellini ; Vice-presidents, representing various nations, amongst them—J. Hall (United States), Sterry Hunt (Canada), W. T. Blanford (India), Prof. Hughes (Great Britain), Prof. Daubrée (France), Prof. Torell (Sweden), &c. ; General Secretary : F. Giordano ; Secretaries : Bornemann, Delaire, Fontannes, Pelar, Taramelli, Topley, Uzielli, and Zezi. The Congress had offered prizes for the best essays upon the colouring, &c., of maps. These were awarded to MM. Heim of Zürich, Carpinski of St. Petersburg, Maillard of Lausanne.

At the conclusion of this meeting the Congress adjourned to the excellent new Geological Museum which has been formed under the direction of Prof. Capellini. The Via Zamboni, in which the Museum is situated, was lined by representatives of all the ancient trade guilds of Bologna, each with its banner. M. Sella took especial pains to explain to the American and English visitors the history and present position of these interesting old societies.

The first sittings of the Congress were devoted to a

discussion of the names to be employed in describing the various groups of beds, on which subject a preliminary report had been prepared by M. Dewalque. English geologists have always used the term "formation" to denote a group of beds, sometimes large, sometimes small; thus we should speak of the Silurian formation or of the Liassic formation. The word is rarely used in this sense by Continental geologists; they use it only as descriptive of the mode of origin or *mode of formation*, or as descriptive of the nature of the material composing the rock. Thus they might speak of the "chalk formation," but never of the "cretaceous formation." It was necessary for the English to make some concession on this point, which should satisfy the representatives of other countries without unduly committing English geologists. Prof. Hughes proposed a resolution recommending the use of the word "formation" as far as possible in the Continental sense.

A long discussion followed respecting the value to be attached to certain words in descriptive geology, and ultimately it was resolved to employ them in the following order, the most comprehensive term being placed first:—

Divisions of sedimentary formations.	Corresponding chronological term.
Groupe	Cycle
Système	Période
Série	Époque
Étage	Age

With regard to the term *Série* a difficulty occurred, in consequence of there being no precisely similar equivalent in the German or Russian languages. This question was referred to the Council, who recommended the use of the terms *Série*, *Section*, or *Abtheilung* as equivalent terms. Also as regards the term *Assise* (subdivision of *Étage*) a reservation was carried leaving each nation to choose the word which most nearly expresses the same meaning (*beds*, *couches*).

There was much more down for discussion, especially with reference to proposed uniformity of language, terminations of words, &c.; but it was resolved to postpone these questions till the next meeting of the Congress, by which time it might be possible to arrive at some common terminology for eruptive rocks, &c.

The second part of the work of the Congress related to the colours and signs employed in geological maps. On this subject a general report had been drawn up by Prof. Renevier, based upon the reports of various national committees. Much has been said about the solar spectrum and its order of colours, and Prof. Renevier's resolution, as originally drawn up, proposed a system of colour based on this natural order; but so many and important deviations from this natural order were recommended by different nations, that it was thought better to omit all reference to the solar spectrum. Resolutions were passed recommending the adoption of a common scale of colours for all nations, especially in view of general maps (*travaux d'ensemble*); but without reference to maps now in course of publication. The following colours were adopted:—

For crystalline schists of Pre-Cambrian age—bright rose-carmine.
,, ,, ,, unknown age—pale rose-carmine.
,, Palæozoic rocks (question reserved for Map Committee).
,, Trias—Violet.
,, Lias—Dark blue.
,, Jurassic—Blue.
,, Cretaceous—Green.
,, Tertiary group—Shades of yellow; the newer divisions to be the lighter tints.

The subdivisions to be shown by shades of the colour adopted, or by coloured lines; the darker shades denoting the older subdivisions. Sedimentary formations to be denoted by the initial Roman capital of the name of the formation; subdivision of formations to be shown, in addition to this, by the initial small letter of the name of the subdivision. Still smaller subdivisions to be shown by figures added to the other signs; the figures to be taken in chronological order—1 denoting the oldest subdivision. Eruptive rocks to be denoted by the initial Greek capital of the name of the rock.

The Congress resolved to prepare and publish a geological map of Europe, and for this purpose a committee was appointed. Any committee having representatives of all the countries of Europe would be too large; it was therefore necessary to limit the number of nations to be directly represented; at first this was fixed at five, but afterwards the committee was increased to eight. Great Britain received the largest number of votes, France coming second, Germany third. The committee was finally elected as follows:—Beyrich (for Germany, and also as director of the map); Daubrée (France); De Moeller (Russia); Giordano (Italy); Hauchecorne (as assistant director); Mojsisovics (Austro-Hungary); Renevier (Switzerland, and also as secretary); Topley (Great Britain). The map will be published at Berlin; the scale was fixed at 1 : 1,500,000; the cost is estimated at about 2500*l.*; and application will be made to the various Governments of Europe for monetary aid.

In most of the countries not directly represented, arrangements will subsequently be made by the committee; but it was settled that Austria should take charge of Turkey, France of Algeria, &c. (or of so much of that district as comes within the limit of the map), Great Britain of Palestine, it being hoped that much geological information, which may be available for this purpose, is in possession of the Palestine Exploration Society.

At a subsequent meeting it was arranged that a committee, formed for the most part of vice-presidents, should be formed to co-operate with the Map Committee with regard to questions of nomenclature, classification, &c. Prof. Hughes represents England on this committee.

One sitting of the Congress was devoted to a discussion of the nomenclature of species. Upon this question only the French committee had sent a report, and no great amount of work was done. The Congress, however, recommended the use of a generic and a specific name, to be followed, when necessary, by that of the variety. The nomenclature to be Latin or Latinised. When the original name of the genus is not preserved, the name of the author of a new specific name is to be placed within brackets.

At the close of the Congress an excursion was made to Florence, Pisa, and the marble quarries of Carrara. For this free tickets or a special train were provided for all members. At each place the municipality received the Congress and did its utmost to render the excursion a success. At Florence the new Museum of Natural History was inspected, and then the Congress adjourned to the crypt of San Lorenzo to place a wreath on the tomb of Steno (who died in 1687), and to hear an oration by Prof. Smidt of Copenhagen. At Pisa the Natural History Museum was visited, this being very rich in geological and prehistoric remains from the district.

An important result of the Congress has been the foundation of a Geological Society of Italy, of which Prof. Meneghini is president, Prof. G. Capellini vice-president, and M. Pantanelli secretary. So much good geological work is now being done in Italy that it is of great importance to collect the scattered workers into one central society.

The next meeting of the Congress has been fixed for 1884 at Berlin, with Dr. E. Beyrich as president; but preliminary meetings, with reference to the geological map of Europe, are to be held next year at Foix, in the Pyrenees (at the annual meeting of the Geological Society of France), and in 1883 in Switzerland. It was generally understood that the fourth meeting of the Congress would be held in England.

THE AUTUMN SKY[1]

II.

AN attempt was made in a preceding paper to point out the most remarkable features of the planets that are at present so attractive for telescopic inquiry. We will now proceed to pass in review a few of the more interesting sidereal objects in that part of the heavens that is well placed for the observer. It is needless to say that within our limits nothing more can be expected than a very scanty selection, for the use of inexperienced students, of some of the most conspicuous of the many hundreds of double stars and nebulæ that are within the reach of ordinary instruments. We begin with the constellation *Hercules*, because it is rapidly gliding away from us, and the search for our first object should be undertaken as early as possible in the evening, especially if we are unacquainted with its position. The possessors, of course, of equatorial mountings and divided circles will readily find anything in our selection from its assigned place; but we propose to give such instructions as may be serviceable with altazimuth stands, aided by any common map, which will be occasionally supplemented by small diagrams. These, it must be borne in mind, correspond with a meridian position, and must be inclined one way or other to represent objects lying east or west of it.

If then we wish to find without an equatorial, set to R.A. 16h. 37m., D.N. 36° 41′, the great globular cluster in the constellation *Hercules*, known as M(essier) 13, we must look out west-north-west for a large triangle, nearly equilateral, of 3rd mag. stars β, δ, ζ, the left-hand angle of which at β is nearest the horizon; at the other end of this side is ζ; if we continue the line $\beta\zeta$ nearly as far again to the right, bending a little upwards, we come upon a similar star η, and between ζ and η, but rather nearer to the latter, our object is found. It is easily visible with the slightest telescopic aid, and discernible even without it in a clear dark sky. It will be instantly recognised as a round ball of misty light, which nearer the meridian would be of considerable brightness. It will not be favourably placed for examination; but those who have once caught sight of it will look out for it in a better position another year. At any time its resolution into stars will of course depend on the aperture; as this and the power are increased the mass will soon begin to sparkle, and the more brilliant points will rise out of the general haze; but it will require a large telescope to resolve it throughout. The great Copenhagen achromatic of 11 inches aperture in the hands of d'Arrest effected it with a power of 95. Its components, ranging according to Sir J. Herschel from 10 or 11 to 15 or 20 mags., must be thousands in number: his father had supposed 14,000. The state of compression, he observes, indicates not much greater density at the centre. Outliers surround it in streaky masses and lines; and the ball, according to the Earl of Rosse, is intersected by three dark rifts confluent towards the centre, which I have perceived, as *known objects*, with my 9½-inch mirror. This is unquestionably the finest specimen of a globular cluster visible in our latitudes; and even when the eye has recovered from its first surprise, it is never weary of reverting to this wonderful object. It may well be called wonderful, even at the distance at which we have to contemplate it. But imagination fails utterly to grasp the magnificence of such a scene, could we be transported to a standpoint two or three of its own diameters distant; or could we penetrate to the heart of the resplendent mystery, flaming on every side with suns innumerable, and where shade would be unknown and impossible. But are those thousands upon thousands suns indeed? We only know that they possess the solar character of intrinsic light; yet that there is something peculiar in that light appears

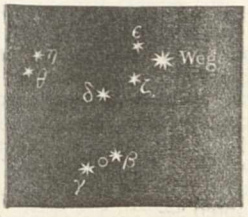
[1] Continued from p. 10.

by modern analysis, which finds the red end of their spectrum deficient; but as to their nature, or their magnitude, or their distance from us, or among themselves; whether they were formed as they are, or have been gradually aggregated through innumerable ages—of all this we know absolutely nothing, and nothing are we ever likely to know. Nor if, as it is natural to suppose, gravitation is an inseparable property of matter, can we conceive how that glorious accumulation can be permanent, or escape ultimate transmutation into a fresh form of existence by the final coalescence of its members. It has indeed been supposed that, under certain admissions as to proportionate distance and velocity, such a mass might be preserved in a permanent condition of rotation; but we are treading here too closely upon the impossible, and though all may continue sensibly unvaried for ages, yet a secret principle must be at work that will issue in a final catastrophe—the opening, it may be, of a new and more glorious existence. We beings of a day can but confess our ignorance and our nothingness in the contemplation of such an evidence of creative power and uncomprehended skill in what is but a minute speck to the keenest eye.

We should not leave this object without noting its beautiful configuration in a large field with neighbouring stars; probably only an optical vicinity. Yet who after all can say which may be the nearest, now that it has been so clearly shown that there is but a precarious relation between apparent magnitude and actual distance?

While we are in this region we should make an attempt to see another remarkable, though less-known, cluster, M 92, R.A. 17h. 13m., Decl. N. 43° 16′.[1] It may be found without circles, by patient sweeping some distance above, and to the left of, the last. Not equal in size to M 13, it is more compressed and more brilliant in the centre; "*formosissimus*" in the Copenhagen telescope. It is a singular circumstance that its spectrum resembles that of M 13.

Next, ever-charming *Lyra*, with its glowing sapphire, *Wega*, the beauty of the northern sky, whose minute 11 mag. attendant at about 46″ is a well-known test for sensitiveness of vision. If this, as we are warranted in supposing, is a sun even more magnificent than our own, a search for a planetary system might not be hopeless. Several observers have actually seen minute points in its immediate neighbourhood, but there is little agreement about them, and they remain for closer investigation. The accompanying diagram may serve to guide us to



1.

some other interesting objects here. Above *Wega*, a little to the left, are the two well-known pairs, ϵ^1, ϵ^2, with the intervening *debilissima;* long familiar to observers. It is no very uncommon feat, though one which I could never accomplish, to separate ϵ^1 and ϵ^2 at 3½′ distance with the naked eye; the subdivision of the pairs, and the ruddier hue of one of the components of ϵ^1, will be apparent with a power of 50 or 60. There is of course an abstract possibility that this beautiful combination may be merely the result of coincident direction: but our optical sense revolts from the demand this would make upon it; and

[1] This glorious object, discovered by Bode, is omitted in Sir J. Herschel's Catalogue.

mere inspection forces home upon us the persuasion that a physically-connected system lies before the eye. As regards each pair separately, the inference is already established by orbital motion—the mutual relation of the whole waits the examination of ages.

The *debilissima* may be watched for a suspicion of variable light. Some very minute points precede them.

ζ, next below and following *Wega*, is a grand wide pair, nearly 44″ apart, 5 and 5½ or 6 mags., topaz yellow and greenish, or, according to others, lilac. Such discordant estimates of colour are of frequent occurrence. They

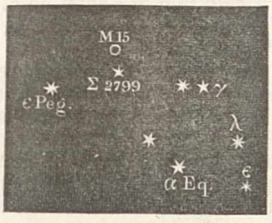
2.

may arise from actual dissimilarity of vision, or an uncertain effect of contrast, or residual chromatic aberration; but we have to remember that these star-hues are often open to question from their feebleness, and especially from the absence of comparison with a light of standard whiteness in the field.

To the left of ζ a low power will show us δ^1 and δ^2 in a fine group, where some beautiful colouring will be found. One of the smaller stars has at times appeared to me of a pale ruby tint, on other nights not traceable. 24′ nearly north of δ^1 Burnham has detected a sma l pair (his No. 137), only 1″·2 apart, and therefore a severe trial for ordinary apertures.

Further to the left the naked eye shows us two small stars at a greater distance: the uppermost, η, 5 mag., has a 9 mag. attendant at 28″; the colour is differently recorded as blue and pale yellow. Three small pairs lie near it. The other star, θ, is also worth looking at for its fine surroundings. But beautiful fields are throughout more or less the character of this constellation.

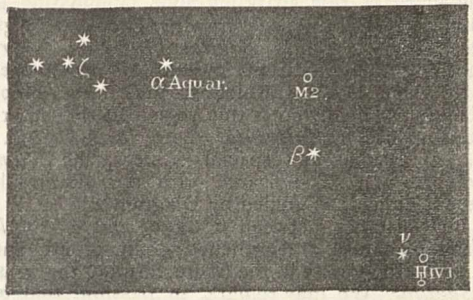
Lower down, and brighter than the two last-mentioned, are two considerable stars, β and γ, of which the right hand one, β, is the centre of a minute group; but more remarkable for variation in its light, with superposed inferior variations, completed in about 12d. 22h. Its



3.

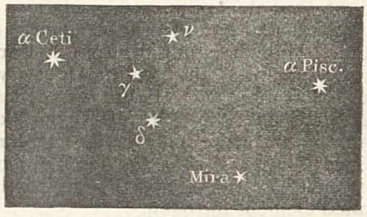
colour is also questionable, yellow, or none. But greater interest attaches to these two stars as guides on either side to the wonderful annular nebula, M 57, the brightest of its class, easy with very slight optical means, refractory with the highest. Its light has been noticed, ever since Schröter's time, to be a little unequal in different parts, and may possibly be variable; the interior is gauzy and streaky, according to the Earl of Rosse, who also represents some exterior wispiness. The idea of its starry composition, maintained by Secchi and Chacornac, has been dispelled by Huggins, whose spectroscope shows only gas. But how produced? how accumulated into that extraordinary shape? how heated into incandescence, and maintaining that temperature, at any rate since 1779, amid the alleged intensity of cold in space—here even conjecture must admit its helplessness. A minute star following it may perhaps be variable.

In sweeping from this region towards the galaxy, we shall cross an abundance of rich and lovely fields; but



4.

the galaxy itself, with a sufficient aperture and low power, is from end to end a scene of wonder and astonishment. Especially in some parts of *Cygnus* its magnificence exceeds all hope of description. But it is not only to be studied for its gorgeous profusion of suns—where in a short time many thousands pass before the eye—nor for the many beautiful pairs that it envelopes—such as the



5.

well-known β *Cygni*, with its elegant contrast; or χ (R.A. 19h. 42m. D.N. 33° 27′), inferior indeed, but very pretty; or the wide pair 61 (R.A. 21h. 1m. D.N. 38° 9′), whose parallax, the first well established, shows that they are nearer to us than the bright leaders of the constellation; or at the end of the right arm of the great cross, δ, whose minute comes at 1″·6 has proved such an annoyance to many a

6.

disappointed observer, who might however have succeeded in a twilight hour; nor again for its groups of irregular and artistic beauty; but for many peculiarities of arrangement, not altogether unrecorded, especially by Secchi, but scarcely adverted to as they deserve. Among the minuter stars, from perhaps the 8th to the 11th mag., configurations are not infrequent of such singular

regularity or peculiarity of arrangement that the idea of optical concurrence seems inadmissible. Triangles, squares, rhomboids, wreaths, festoons, coronets, indicate a collocation utterly inscrutable, but certainly not fortuitous. Such combinations are occasionally met with in other regions, but, as might be expected, are accumulated in the galaxy.

The glory of this sparkling zone, culminating in the splendours of *Cygnus*, is everywhere repeated in greater or less degree. *Aquila*, *Sagitta*, *Vulpecula*, *Lacerta*, to say nothing of more distant regions, all present fields of most gorgeous richness, which we must leave unnoticed. But before we finally cross this region to the other side, we must pause in *Vulpecula*, where, in R.A. 19h. 54m. D.N. 22° 23′, lies an especial mystery, the *Dumb-bell Nebula* (M 27). The search with the altazimuth will prove not difficult as guided by Diagram 2.

In mid-distance between *β Cygni* and *α Aquilæ* we we shall recognise a lengthened group of 4th and 5th mag. stars, the lowest in the figure, forming the constellation *Sagitta*. We may remark, in passing, that one of these, *ζ*, R.A. 19h. 44m., D.N. 18° 51′, is a very pretty wide double, the largest of which has been found by Alvan Clark, jun., to be an excessively close pair. Nearer to *β Cygni*, but to the left, is another less marked group, forming part of *Vulpecula*, close to one of the stars of which, in a rich field, we shall perceive two oval hazy masses in lateral contact, the nebula in question.

Like other objects of the same nature, this has been seen, or at any rate, drawn, in very dissimilar ways; it seems in fact almost inseparable from the character of nebulous light that its limits and gradations should be differently appreciated by different observers; and in this instance the additions resulting from larger apertures have almost obliterated the original idea; yet without suspicion of actual change. Minute twinklings are easily seen in the haze; and the Earl of Rosse finds a much greater abundance of stars than in the surrounding sky; yet he does not resolve it; and the spectroscope shows it as a huge mass of incandescent gas—apparently the little-comprehended element nitrogen.

Quitting now the galaxy for the region on its eastern side, we notice, a little above *α* Aquilæ, the familiar lozenge of *Delphinus* (a curious instance of configuration) the following or left-hand component of which, *γ*, is a noble pair of 4th and 7th mags. at nearly 12″, and somewhat differing in colour now, though Sir W. Herschel called them both white in 1779. Physical connection is inferred from an extremely slow relative movement; more decidedly from a motion through space common to both—an unsolved and insoluble mystery. South of *γ*, a little to the west is Σ 2725, a very pretty little couple, at 4″·2; possibly of binary character.

A little further south-east we shall find another less conspicuous group of small stars, chiefly in the form of a trapezoid. This is *Equuleus*. It is given in Diagram 3, where *α* is at the lowest angle.

Here *γ*, the 4¾ mag. star nearest *Delphinus*, forms a striking combination with one of 6th mag., and has itself been doubled by Knott with an 11 mag. comes at 2″·1. And beyond the limit of the trapezoid to the south-west we find a very fine triple, *ε*, R.A. 20h. 53m., D.N. 3° 50′, the two closest of which are a beautiful pair in slow rotation, whose distance, less than 1″, renders it an excellent test for a moderate aperture. The third star also appears to be physically connected with the others. *λ*, readily found by sweeping less than 3° north of the last, and a little east, is also well worth looking for: 6 and 6½ mags. at about 2″.

We shall now cross the border into *Pegasus*, the leader of which, in respect of position, *ε*, is represented in the same diagram; a bright yellow 2½ mag. star with 2 comites, 9 and 14 mags. Sweeping rather more than 2¼° north of this, about 14m. west (R.A. 21h. 24m., D.N. 11° 38′) we shall come upon M 15, a noble globular cluster, of similar character to M 13 in *Hercules*, but of smaller size. Sir J. Herschel gives the stars 15 mag. of his scale, running up to a central blaze, and more condensed there than according to the idea of equal distribution. It is not quite circular, and surrounded with outlying streams. Buffham, with a 9-inch "With" mirror, has detected a dark patch near the centre, and two faint rifts like those in M 13, traces of one of which I think I once perceived. This fine object deserves a long and steady gaze.

About 1° south of the cluster, a little west, we shall readily find a beautiful pair, perhaps slow binary, Σ 2799, both 6·6 mag. of Struve's scale, 1″·4 distant.

Ranging east and west, at some distance below *ε Pegasi*, we shall remark the subject of Diagram 4; part of *Aquarius*. At the east end a very remarkable pair, *ζ*, R.A. 22h. 23m., D.S. 0° 38′, will be found in the interior of an easily-recognised triangle of stars, not much differing in brightness. The magnitudes are given 4 and 4½; the distance 3″·6; the binary character is certain, and the period last assigned 1625 years. This is an excellent object for a small telescope, and will lead to many wondering thoughts as to the possible state of existence there. A much larger aperture will be required to secure Burnham's little pair, 8½ and 10 or 11 mag. at 1″·5, 11′ south of *ζ*.

To find our next object, M 2, R.A. 21h. 27m., D.S. 1° 22′, by sweeping, we must note its configuration in the diagram with *α* and *β*, two stars conspicuous for insulation in a dull region. It will repay the search, being, not indeed a brilliant, but a very interesting ball of several thousand very minute stars, 15 mag. of Sir J. Herschel, "a most superb cluster" in his reflector, "like a heap of fine sand," blazing in centre: D'Arrest sees it of irregular form. What an object, could we reach its neighbourhood!

But perhaps more surprising, though in quite a different way, is the next, H iv. 1—that is, No. 1 in Sir W. Herschel's fourth class—a noble specimen of what, from their equable light and defined edges, the illustrious discoverer termed Planetary Nebulæ. It lies in R.A. 20h. 58m., D.S. 11° 50′, and, to find it, we may carry a line through *α* and *β* nearly as far again, bending a little downwards: this will point out *ν*, a 5th mag. star, a little west of which we shall catch our object. It is tolerably bright, slightly elliptical, and of a pale blue tint. Lassell has seen a luminous well-defined ring in its interior; Buffham, with 9-inch mirror, an opening. The Earl of Rosse, besides many faint projections, finds a narrow ray on either side, making the whole a singular resemblance to Saturn with a very thin presentation of the ring. Yet here too is gas! and as it seems, nothing but gas! But whence? how? wherefore?

And now we pass to the left over a long and rather dull region from the triangle in *Aquarius* to the chief star of *Pisces*, at the extremity of the constellation, about 20° under the well-known three stars that mark the head of *Aries*. *α Piscium* with the head of *Cetus* east of it are shown in Diagram 5. It is a fine pair, 5 and 6 mags. at 3″·2, the tints of which, as well as the mags., have been described with greater discordance than can be easily explained. *α Ceti*, the next conspicuous star to the east, is a very beautiful specimen of a large orange star, with a blue companion at a little distance, the colour of which may possibly be due to contrast, or heightened by it: this might be ascertained by hiding the great leader behind the edge of the field. There is a pretty little pair near them. The next star to the right, *γ*, is a striking double, 2″·6 apart, 3 and 7 mags., yellow and blue (greenish, ruddy, or tawny to some eyes). Above and to the right of this is *ν*, 4½ mag., attended by a very minute companion, a glimpse star to Smyth, but much easier of late. Below *ν*, a little to the right, is *δ*, a line through which from *α* will point out a very remarkable variable, *ο*,

or Mira Ceti, R.A. 2h. 13m. D.S. 3° 31′. This changes from 2 mag. to equality with a very minute companion in about 331d. 8h. 4m., but not without some uncertainty. Its colour, according to Sir J. Herschel, is a full ruby; I saw it so once, when about 10 mag., if it was the right star, but it was immediately clouded over: at another time, near *maximum*, pale yellow, without a trace of red. Flammarion also finds it by direct comparison less red than a gas flame. This tint would be an interesting object of study; but care must be taken in identification. Mira is now decreasing.

Having mentioned the head of *Aries*, we must recollect that γ, the smallest of the three stars, is a double, interesting as the first of these objects recorded by Hooke in 1664, and a fine object, nearly 9″ distant. These three stars are introduced into this diagram as guides to *Triangulum* just above them, where we shall find our last two objects.

ι, R.A. 2h. 5m., D.N. 29° 44′, topaz and green, an exquisitely coloured pair, 5½ and 7 mags., distance 3″·5; perhaps in slow orbital motion. We shall pick it up about ¾° north of α, a little to the east. The other is a strange phænomenon,

M 33, R.A. 1h. 27m., D.N. 30° 4′, about 1° north of α, and not far towards the west. Feeble as it is, it will be visible even with a very small aperture, from its great extent; fully ½°, or the diameter of the moon, from north to south; but on the other hand may, from want of contrast, be imperceptible with any but a very low power. The elder Herschel thought it was resolved into the minutest possible stars; but this has not been confirmed. His son and d'Arrest find a principal condensation with subordinate nuclei and nebulous tracts; the Earl of Rosse, a flocculent and spiral structure, with curved intersecting branches; a strange, incomprehensible form.

Our space will not admit of an extension of this very meagre and imperfect selection, limited for the most part, for obvious reasons, to such portions of our autumnal sky as are rapidly passing away. T. W. WEBB

AN OBSERVATORY FOR HONGKONG

WE observe that Sir John Hennessy, the Governor of Hongkong, has succeeded in getting an item of twenty thousand dollars for an observatory and time ball passed by his Legislative Council in the estimates for the current year, in addition to a sum of ten thousand dollars voted for the same purpose last year. The advice of Major H. S. Palmer, of the Royal Engineers, has been sought by the Colonial Government, and in a valuable paper published in one of the most recent Government Gazettes, he details the advantages, imperial and local, which may be expected from a physical observatory in Hongkong. The favourable position of the island for certain observations, especially with regard to the typhoons of the China Seas, on meteorology generally, and on terrestrial magnetism, was first brought to the Governor's notice in September, 1879, through the Secretary of State for the Colonies, by Dr. Warren De La Rue, as Vice-Chairman of the Kew Committee of the Royal Society. He pointed out the extreme importance of obtaining accurate records of the magnetic and meteorological conditions of the China Seas. There are at present only four observatories at which continuous observations are taken on the eastern coast of Asia and the adjacent islands—one at Batavia, in Java, supported by the Dutch Government, one attached to the Russian embassy at Peking, one at Siccawei, near Shanghai, and one at Manila. The two last are supported by the Society of Jesus. It is pointed out that Hongkong divides the distance between Siccawei and Manila, and would consequently be a most valuable acquisition to the list. The support of the Government of the Colony for a limited number of years to an observatory provided with self-recording instruments is therefore invoked. English officials and merchants abroad do not as a rule display much interest in science, and it is therefore fortunate that the gentleman at present at the head of the Government of Hongkong is one capable of appreciating the great importance of Dr. De La Rue's suggestion and of energetically carrying it out. Governor Hennessy had indeed in some sense anticipated the request, for he had, two years previously, in the first estimates which he prepared for the colony, obtained five thousand dollars from his Council for an observatory and time-ball. He entirely agreed with Dr. De La Rue's remarks, and added that the clearness of the atmosphere at certain seasons would admit of a valuable record being made of sun-spots, while the tides and varying temperature of the seas surrounding Hongkong, and the slight but frequent earthquake phenomena, would also be deserving of the attention of competent observers. A sum of between thirty and forty thousand dollars has been granted altogether for the establishment of an observatory, the chief objects of which are—

1. To determine the local time by astronomical observations, and drop a time-ball daily.

2. To obtain a series of meteorological observations with instruments of the best kinds, and to acquire information relating to the typhoons and monsoons of the China seas.

3. To obtain a series of observations in terrestrial magnetism, also with the best modern apparatus.

In his report Major Palmer addresses himself to each of these subjects separately. He recommends, we are glad to notice, that none but the best instruments should be employed, and that the observatory records should be made and published with scientific precision, and be such as to command public confidence. The meteorological department, he points out, besides furnishing science with valuable data from a locality well suited for the observation and collection of facts appertaining to certain phenomena of special interest, cannot fail to have a direct and practical value by affording security, by its predictions and weather-warnings, to life and property in seas navigated by vast numbers of native and foreign vessels, but subject, during four or five months of the year, to rotatory storms of appalling violence and danger. Its operations, as well as its purpose, would be twofold. There would be the systematic observation and record of the ordinary phenomena of pressure, temperature, humidity, rain, sunshine, wind, and hydrometeors, such as are usual in observatories of the first order, and observations of atmospheric electricity. The second branch would be the observation and collection, as far as possible, of facts and phenomena relating to typhoons, both for the protection of marine interests and for the purpose of contributing bit by bit to our knowledge of a subject at present but little understood. He recommends that measures should be taken to enable the director of the observatory to be placed in prompt telegraphic communication with Manila, Amoy, Shanghai, Saigon, and Singapore, as well as with the south of Japan, and indicates the steps necessary for this purpose.

As for terrestrial magnetism, the character of the rocks and soil of Hongkong, and the neighbouring promontory of Kau-lung, is not, he thinks, the most favourable that could be chosen for magnetic research, yet the position of the colony on the magnetic chart, and with respect to other places where observatories are already established, leaves no room to doubt the value of well-conducted observations.

As to the staff of the observatory, a director, Major Palmer very properly suggests, should be obtained through the Astronomer-Royal, and thinks a salary of not less than 700*l.* a year should be given. Minor officers could be obtained among the non-commissioned officers of the Ordnance Survey Companies of the Royal Engineers. The prime cost he estimates at 6300*l.*, and the

subsequent annual charge at about 2000*l*. It would seem therefore that we may shortly expect to find a tolerably complete and well-equipped observatory in the most eastern of our possessions. It is believed also that, with the assistance of Mr. Hart, the Inspector-General of Chinese Customs, the Government of China may be induced to establish a series of meteorological stations at various points on the seaboard of their vast territory. A perusal of Major Palmer's report leaves on our mind the impression that the Colonial Government is fortunate in being able to obtain at the present time the advice and co-operation of an officer of his ability and scientific attainments.

PROBING BY ELECTRICITY[1]

THE instrument[2] I have the honour of presenting to the Academy has for its object the determination of the exact place occupied by balls of lead, fragments of shell, or metallic substances of any kind embedded in the body of a person wounded by firearms; and it may be considered as a form of the well-known induction-balance of Prof. Hughes.

This exploring instrument enables us to determine that position for the most part with very great exactness, and that without any pain to the patient, which is not the case when we use metallic probes, which require to be brought into direct contact with the projectile.

The instrument is composed essentially of a system of two parallel flat coils partially superposed upon one another in such a manner that the edge of one is nearly over the axis of the other (Fig. 1). One of these coils

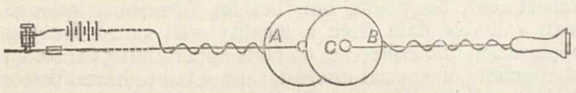


FIG. 1.

(A) is made of thick wire constituting a portion of the primary circuit, and the other (B) of thin wire, constituting a portion of the secondary circuit. Both coils are imbedded in a mass of paraffine placed in the interior of the wooden case furnished with a handle.

A vibratory current from a galvanic battery traverses the primary coil, and the secondary circuit includes an ordinary telephone. Under these circumstances no sound is heard from the telephone; but if we cause any metallic body to approach the part (C) common to the two coils, the silence immediately gives place to a sound the intensity of which will depend upon the nature of the metallic body, upon its form, and upon its distance. We may remark in this connection that the most favourable form that can be assumed by the projectile for which we explore, is that of a flat disk with its face parallel to the surface of the skin, and that the most unfavourable, a similar disk with its face perpendicular to the same surface.

It is difficult in practice to obtain the exact adjustment of the coils required, and it is therefore found advisable to introduce into the primary and secondary circuits respectively two other coils (D and E, Fig. 2) analogous to the first, but very much smaller, whose common surface can be modified by the play of a micrometer screw.

By means of this fine adjustment we are able easily to reduce the telephone to the most complete silence. It should be added that the effects obtained when a condenser (F) is introduced into the primary circuit are much inferior to those obtained without, as had been independently predicted by Prof. Rowland of Johns Hopkins University.

If we wish to ascertain the depth at which the metallic mass lies embedded this is easily ascertained if we know *à priori* its form, its mode of presentation, and its substance. It is only necessary to adjust the apparatus to

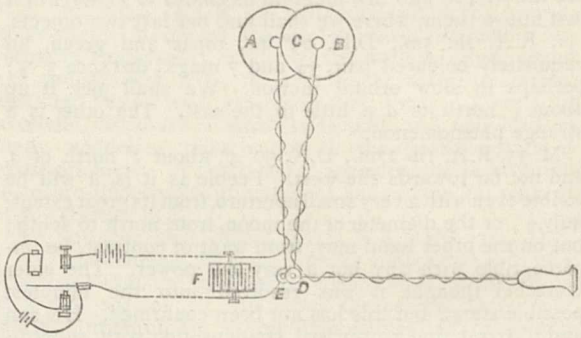


FIG. 2.

silence while it is applied to the skin, after which, removing the apparatus, we bring near it another metallic mass similar to that explored for, so as to reproduce silence anew, and the distance of this mass from the exploring instrument gives the measure which it is desired to determine.

I conclude this Note by the relation of an experiment made in the office of Dr. Frank Hamilton of New York, on October 7 last, in the presence of thirteen eminent surgeons.[1] The experiment was made upon the person of Col. B. F. Clayton, wounded in 1862. The ball entered in front through the left clavicular articulation, breaking the clavicle. Doctors Swineborne and Vanderpool supposed that it was lodged under the scapula, but my apparatus demonstrated, on the contrary, that it was located in front and just below the third rib.

[1] Upon an Apparatus for Determining without Pain to the Patient the Position of a Projectile of Lead or other Metal in the Human Body. Note by Prof. Alexander Graham Bell, read by M. Antoine Breguet at the Paris Academy of Sciences. Contributed by the Author.

[2] This instrument has originated from researches undertaken in the Volta Laboratory at Washington on the occasion of the sad attempt upon the life of President Garfield. This Note is preliminary to a paper which I shall publish shortly, giving a complete account of these researches. So many different persons have been kind enough to give me the benefit of their suggestions and advice concerning the method of exploration for this object, that I can only mention here the names of a few: Prof. Hughes, George M. Hopkins, Sumner Tainter, Thomas Gleeson, Dr Chichester A. Bell, Charles E. Buell, Prof. Simon Newcomb, Prof H. A. Rowland, M. Rogers, Prof. John Trowbridge, J. H. C. Watts, the director of the Western Union Telegraph Company at Washington, and the correspondent of the *New York Tribune* at Washington.

MAGNETIC SURVEY OF MISSOURI

IN NATURE, vol. xxiii. p. 583, the writer presented a chart of magnetic declination which represented the results at forty-five stations in Missouri. The facts seemed to indicate a marked effect due to contour. Up to the middle of August of the past summer nothing inconsistent with this explanation was found, although the number of stations had been increased to over eighty. By that time the stations had become so numerous in Central Missouri that a more minute survey along the river bank between Jefferson City and Glasgow gave promise of affording a crucial test. It was necessary that the 8° line, which bends down the river, crossing at some point east of the mouth of the Osage River, should *return* on the south side of the river, looking something like a reversed contour line.

What we did find was, that the 8° line crosses the Missouri Valley *without bending*, running south-west to near the summit of the "divide" between the Osage and Missouri rivers, and *then* bends abruptly to the north-east, re-crossing the Missouri above Jefferson City, and

[1] Doctors G. H. Gardner, G. Durant, Ed. Birmingham, N. Bozeman, L. Damainville, J. N. Hinton, Francis Delagield, F. H. Hamilton, D. Chamberlain, Elias Marsh, J. G. Johnson, Joseph Halderson, and J. G. Allan.

after a wide *détour* re-crosses east of Hermann, returning to the south-west, thus forming an immense cape-like area of maximum declination to the east of Jefferson City. It is therefore improper to regard the chart referred to as more than a representation of observations then made, although the stations were more numerous than is usually deemed necessary for an area of 60,000 square miles.

The area of minimum declination represented on the chart of April 21 has been more satisfactorily outlined, and a closed area of maximum declination lying to the west has been determined with certainty.

The work of the past summer has therefore increased the complexity of the isogonic lines, and the *gradual* change in declination in passing through these areas of abnormal value shows that the causes must act over areas of from 1000 to 3000 square miles, *i.e.* that the observed effect is not due to minute local causes at the several stations. It will not be possible to determine fully the extent of these abnormal influences until similar work done in adjoining States shall enable a more precise determination of *normal* values. The stations of observation in Missouri now number over 100. Arrangements for the summer of 1882 have already been made, and the survey will be carried forward on a still more extended scale. FRANCIS E. NIPHER

St. Louis, October 8

THE ECHINOIDS OF THE "CHALLENGER"

ZOOLOGISTS in general, and echinologists in particular, will welcome vol. iii. part 9 of the "Report on the Scientific Results of the Voyage of H.M.S. *Challenger*," which has just been published. It deals with the Echinoidea, and has been prepared by Prof. A. Agassiz, a more competent reporter than whom it would be difficult, if not impossible, to find. We do not propose to do more than give a brief outline of the principal results brought to light in this portly volume, which runs over some three hundred pages of text, and is illustrated by sixty-five plates.

Commencing with a few remarks on classification, Prof. Agassiz passes on to treat at more length of that vexed question of the position of the axis of the Echinoidea. He dissents from the theory put forward by Lovén in his "Études," a memoir which, however much one may differ from it, cannot be read without a feeling of admiration of the "infinite skill"—to quote Prof. Agassiz's happy expression—displayed by the author. Our reporter again asserts the position he has all along held, that, judging from embryological data, the position of the axis is in the main determined by that of the madreporiform plate. Next in order he deals with the structure of the coronal plates, the anal system, the fascioles, and the structure of the spines. In connection with the latter subject Prof. Agassiz takes exception to some views which we have elsewhere put forward as to the systematic value of acanthological characters. His opinions on any point of Echinoid structure merit the highest respect, and so we do not propose to enter here into an examination of his criticism on our work—a criticism, be it said, which is conceived in the true scientific spirit. A more fitting opportunity will offer itself in a further communication on the subject with which we are at present engaged. The reporter then goes on to notice with extreme aversion the attempts to construct "genealogical trees" "which have become so fashionable." In spite of Prof. Agassiz's well-earned reputation, however, one reads with a sort of shudder the assertion that he is about "to show once for all how futile it must be to carry on" these attempts, especially when we remember the men of mark who engage in them. But a genealogical tree is a upas tree to Prof. Agassiz, and he attacks it with hearty good will, albeit we think that the mathematical axe which he wields is by no means so destructive as he appears to believe. That relations exist between the different groups of Echini no one knows better than Prof. Agassiz, and in the next two or three sections of his Report he shows how well he can use his knowledge in the interesting connections he traces between recent and fossil Urchins, and since this relation does exist we cannot see why the attempt to indicate it graphically or descriptively is to be condemned as futile, even though there may be a minimum of 2^{19} possible combinations of variables. Having passed in review the relations between recent and fossil Echinoids the reporter then comes to what is the real sum and centre of his Report, the description of the species and genera, and here we have an abundance of most interesting matter.

The *Challenger* Expedition has added fifty-two new species, comprised in fifteen new genera, to our list of Echinoids, a very considerable addition when we remember that the order is a comparatively small one. The group which has been most largely increased is that of the Echinothuridæ, of which twelve new species have been described, whilst of the Echinometridæ, Clypeastridæ, and Spatangina only previously known forms have been obtained. It would be of course out of the question to notice all the interesting facts brought to light here; the Report itself must be read for this, and we are fain to content ourselves with a few passing remarks on some of the more striking forms. The remarkable genus Asthenosoma, which was established by Grube in 1867 (Calveria, Wyville Thomson, 1869) to contain an Urchin with a flexible test has been increased by the addition of five new species with a very varied bathymetrical range, one having been obtained at 10 fathoms and another at 1400. Wyville Thomson's genus, Phormosoma (1874), has afforded seven new and most interesting species, inhabiting, as a rule, deeper water than its companion genus (255 fathoms to 2600 fathoms). To this genus belongs the honour of furnishing the largest Urchin which Prof. Agassiz has hitherto met with, *Ph. hoplacantha*, Wy. Thoms., measuring 312 mm. in diameter—truly a good-sized specimen. Amongst the Didematidæ we have a remarkable new genus, Aspedodiadema, with the abactinal system and ambulacral plates of a Cidarid combined with the thin test and hollow spines of a Diadema. Micropyga is another hitherto undescribed genus of the same family. Passing over the Echinometridæ (no new species), the Temnopleuridæ (three new species), the Triplechinidæ (one new species), and the Clypeastridæ (no new species), we notice amongst the Petalosticha thirteen new species of the curious genus Pourtalesia (A. Agass., 1869) with its remarkable beaked test; and, amongst other new genera, Cystechinus, which appears to be related to the fossil genera Galerites and Ananchytes. We might go on for a long time noting one interesting form after another, were it not that to do so would make this notice inordinately long. How far further study and discovery will affect the number of genera and species enumerated here it is impossible to say, but as Prof. Agassiz is by no means given to multiplying species, and as most of the specimens appear to have been well preserved—only a few having been described from fragments—it is likely that the greater number will stand. A word in conclusion as to the plates. The majority of them have been drawn by Mr. Roetter, and we congratulate Prof. Agassiz on having at his disposal the services of so gifted a draughtsman. Many of the plates are to our mind very gems of lithographic art. The drawings of the sections of spines, though very pretty, and in most instances handled with great delicacy and finish, do not always give the clearness of detail that could be desired, and the mechanical arrangement both of these plates and of those containing the pedicellariæ and the side views of spines is decidedly objectionable. It may be that Prof. Agassiz and his

artist have constructed some subtle key whereby they can discover at once the position of any required figure, but it is hidden to our clumsier intellect; and when a plate contains from thirty to fifty-nine figures, numbered apparently without any definite order, the task of picking out any given figure becomes rather tedious. Having said this, however, we have said all that we think we can say against the beautiful plates which accompany Prof. Agassiz' most interesting "Report on the Echinoidea of the *Challenger*."

H. W. MACKINTOSH

NOTES

THE anniversary meeting of the Royal Society will be held, as usual, on St. Andrew's Day, the 30th inst. The following is the list of the Council and Officers nominated for election:—President, William Spottiswoode, M.A., D.C.L., LL.D.; Treasurer, John Evans, D.C.L., LL.D.; Secretaries, Prof. George Gabriel Stokes, M.A., D.C.L., LL.D., Prof. Michael Foster, M.A., M.D.; Foreign Secretary, Prof. Alexander William Williamson, Ph.D.; other members of the Council, Francis Maitland Balfour, M.A., I. Lowthian Bell, F.C.S., Sir Risdon Bennett, M.D., Prof. Thomas George Bonney, M.A., Prof. Heinrich Debus, Ph.D., Alexander John Ellis, B.A., Sir John Hawkshaw, M.I.C.E., Thomas Archer Hirst, Ph.D., William Huggins, D.C.L., LL.D., Prof. Thomas Henry Huxley, LL.D., Prof. Joseph Lister, M.D., Prof. Daniel Oliver, F.L.S., Prof. Henry Enfield Roscoe, B.A., LL.D., Warington W. Smyth, M.A., Henry Tibbats Stainton, F.G.S., Edward James Stone, M.A. Prof. Huxley having retired from his office as one of the secretaries, as we intimated last week, Dr. Michael Foster has been named in his stead.

THE Treasury has, it is stated, awarded the late Astronomer-Royal, Sir George Airy, a pension of 1100*l.* per annum, in consideration of his long and valuable services.

MOST of our readers will have heard with regret, and probably surprise, that Prof. Ferrier has been charged with a breach of the Vivisection Act. On the general question our opinion is well known, but into the merits of this particular case we cannot enter so long as the trial is pending.

THE Queen has conferred the honour of Knighthood upon Mr. Erasmus Wilson, President of the Royal College of Surgeons.

THE death is announced of Dr. Bouillaud, the *doyen* of medical science in France, and Member of the Academy of Medicine and Academy of Sciences. He was born at Angoulême in 1796.

THE impending change in the French Cabinet has brought forth an unusual number of regulations from the Minister for Public Instruction. Two of the more notable are the creation at Limoges of a Government school for industrial arts and a general reorganisation of the veterinary schools of Alfort (near Paris), Lyons, and Angoulême.

M. KELLER, who is a Member of the French Senate, has met with an accident in his laboratory. His hand has been severely burnt by an explosion, and he will probably not be able to resume work for a month.

THE experiments at the Paris Opera with the electric light have been successful so far as concerns incandescent light, which is now regularly used. A final decision on the matter will be come to very shortly.

OUR Paris Correspondent writes that the success of the Siemens Electrical Railway has been so great that the Municipal Commission appointed to report on the possible application of electricity will advise the experiment of an elevated railway in some part of Paris. The only objection to the erection of such a line on the Boulevards is its aspect, which it is supposed will not be sufficiently ornamental. A large number of practical suggestions will be made by this Commission.

THE Russian Government has made a grant of 14,000 roubles for next year for two Polar observing stations:—One at the mouth of the Lena, and the other, of second rank, but also for meteorological and magnetic observations, on one of the islands of New Siberia.

THE Corporation of Chesterfield deserves credit for their enterprise; they have decided to dispense with gas entirely as far as public lighting is concerned, and to replace it with the electric light. The lighting will be done by means of about twenty-two Brush "arc" lamps and about seventy Lane-Fox incandescent lamps. Doubtless the example of Chesterfield will soon be followed by other towns.

THE Council of the Society of Arts, on the recommendation of the judges in the late competition of plant labels, are prepared to renew the offer of a Society's silver medal, together with a prize of 5*l.*, which has been placed at their disposal for the purpose by Mr. G. F. Wilson, F.R.S., for the best label for plants. The object of the offer is to obtain a label which may be cheap and durable, and may show legibly whatever is written or printed thereon; the label must be suitable for plants in open border. These considerations will principally govern the award. Specimen labels, bearing a number or motto, and accompanied by a sealed envelope containing the name of the sender, mus be sent in to the secretary of the Society not later than May 1 1882.

THE Royal Commission on Technical Instruction, presided over by Mr. Samuelson, M.P., has begun its work in Paris by visiting the École d'Apprentis in the Boulevard de la Villette, the École d'Horlogerie in the Faubourg du Temple, and those communal schools in which handicrafts are taught. After inspecting the secondary and higher technical schools of Paris the Commissioners will proceed to Chalons, Lyons, Rouen, and some manufacturing towns in the North of France.

AT the ordinary meeting of the Council of the Sanitary Assurance Association, held at the offices, 5, Argyll Place, Regent Street, on Wednesday, October 26, Prof. Hayter Lewis, F.S.A., in the chair, certificates were issued under the Corporate Seal of the Association to those subscribers who had carried out the recommendations of the Association with regard to the sanitary arrangements of their houses. These certificates, which are as yet a new feature in connection with provident householding, are not of less importance than Fire Insurance polices. The certificates are signed by the chief sanitary officer of the Association, Prof. Corfield, M.D., and the surveyor, Mr. Mark H. Judge, and they guarantee the satisfactory condition of the houses to which they refer; the inspection, report, and supervision of the work, where alterations are necessary, being made personally by both officers. The certificates are issued subject to an annual inspection of the property, for which the members are charged a small fee, according to the rateable value of the houses; for instance, for a house rated at 80*l.* the fee is half-a-guinea for each annual inspection, while for a house rated at 200*l.* the fee is two guineas. Detailed reports of works in progress were made, and correspondence thanking the Council for the thoroughness of the reports and supervision of work was read. It is just twelve months since the first meeting of the Association was convened, under the presidency of Sir Joseph Fayrer, K.C.S.I., to form an organisation which should apply the combined sanitary knowledge and experience of medical men, architects, and others by means of specially qualified officers who should yearly inspect the houses of members and report upon their drainage, water supply, and ventilation. The Association was soon after incorporated by special licence of the Board of Trade, by which it is bound to apply the whole of the income and property of the Association solely towards the promotion of its objects, and no dividend or profit can be paid directly or indirectly to the members. The work of the Associa-

tion is very simple in plan. Application is made for the inspection of a house, and the inspection is made personally by both the chief sanitary officer and the surveyor, who supply a detailed report on the sanitary condition of the property, together with a specification of the work necessary to put it into a condition satisfactory to the Association. While this work is in progress it is supervised by these officers, and on its completion the Council grant a certificate guaranteeing the sanitary condition of the property, subject to an annual inspection by the officers of the Association.

AT an examination held by the Sanitary Institute of Great Britain on November 3 and 4, eight candidates presented themselves, and the Institute's Certificate of Competency as Local Surveyor was not awarded, but the Institute's Certificate of Competency as Inspector of Nuisances was awarded to J. Horrocks, W. Sortwell, and J. W. Witts.

THE Linnean Society of New South Wales has had the enterprise to organise a course of lectures on zoology, open to all who care to take advantage of them. They begin on October 4, and are to extend to December 9, about two lectures being given each week. The lecturer is Mr. W. A. Haswell, M.A., B.Sc.

IT is announced, we learn from the *Lancet*, that the three volumes of the *Transactions* of the International Medical Congress will be published and ready for distribution at the beginning of December. To non-members the price of the work will be 30*s*., and the volumes can each be bought separately. The first volume will contain the list of members, accounts of the general meetings, the general addresses, the description of the specimens exhibited in the museum, and the transactions of the sections of anatomy, physiology, pathology, and materia medica and pharmacology. Volume II. will contain the transactions of the sections of medicine, surgery, State medicine, military medicine and surgery, obstetric medicine and surgery, and diseases of children. Volume III. will contain similarly the transactions of the sections of ophthalmology, mental diseases, diseases of the skin, diseases of the throat, diseases of the ear, and diseases of the teeth. Orders for the work will be received by J. W. Kolckmann of Langham Place.

BULLETIN No. 6 of the United States Entomological Commission consists of a General Index and Supplement to the nine Reports on the Insects of Missouri, by Prof. C. V. Riley, forming in itself a volume of 177 pages. It is very complete. All the descriptions of new species described in the Reports are reproduced, with such alterations indicated as time may have rendered necessary. It is carefully analytical, and one heading will strike many as introducing a comparatively new term, *i.e.* the "List of descriptions of the *adolescent* states."

WE have already referred to the Smithsonian Report for 1879. Mr. O. J. Mason's bibliography of Anthropological Investigations, which appears in the Report, has been separately reprinted, and will be found useful by those interested in the subject.

DR. OTTO FINSCH, whose scientific journey in Polynesia we have repeatedly referred to, arrived at Wellington, New Zealand, in June last, and now intends returning soon *viâ* Sydney.

THE additions to the Zoological Society's Gardens during the past week include a Tiger (*Felis tigris* ♀) from Assam, presented by Col. Owen Williams, M.P., F.Z.S.; a Black Bear (*Ursus americanus*) from North America, presented by Capt. McPherson, barque *Ocean Nymph*; two Common Polecats (*Mustela putorius*) from France, presented by M. P. Pichot; a Young Ostrich (*Struthio camelus*) from Africa, presented by Mr. William Jerram; a Great Eagle Owl (*Bubo maximus*), European, deposited; three Common Curlews (*Numenius arquata*), two Red-throated Divers (*Colymbus septentrionalis*), European, received on approval.

OUR ASTRONOMICAL COLUMN

DOUBLE-STARS.—An important series of observations of double-stars has been recently issued from the United States Naval Observatory at Washington. It includes all the measures made by Prof. Hall with the 26-inch refractor from 1875 to 1880, and a few in the year 1863 with the 9·6-inch equatorial. There are observations of double-stars selected by M. Otto Struve for the comparison of micrometrical measurements by different astronomers, which remain for discussion when those of other observers are published. In addition, in order to apply a geometrical test to the observations, Prof. Hall has carefully measured the multiple stars Σ 2703 and 311, and the stars in the trapezium of Orion. The observations have been made with the filar-micrometer by A. Clark and Sons, which is commonly used with the large equatorial. Then follow measures of objects chiefly taken from the catalogues of the Struves, with a few others mostly discovered by Mr. Burnham. Σ 2 was not separated with power 888 in 1879. Of γ^2 Andromedæ we find the angle 101°·0 distance 0″·358 for 1878·21; 40 Eridani (B.C.), 125°·0, 3″·515 for 1879·18. A great change is shown in O.Σ. 82; we have 230°·8, 1″·08 for 1848·67, while Prof. Hall's measures give 182°·25, 0″·765 for 1879·16. Mr. Marth's faint companion of Sirius, estimated 13m., was at 114°·9, 71″·4, at the epoch 1847·47, which, compared with the particulars at p. 38 of *Memoirs* R.A.S., vol. 36, indicates fixity. Prof. Hall remarks on the supposed companions of Procyon, "I have never been able to see any of these companions that would stand the test of sliding and changing the eyepiece, turning the micrometer, &c., and am therefore doubtful of their existence. This is an interesting star for the powerful telescopes of the future." Six nights' measures of 25 Canum Venat. give 157°·5, 0″·507 for 1879·49; Dr. Doberck has calculated elements for this star, period 124½ years. γ Coronæ Borealis was single in 1875-76 and 1879. 72 Ophiuchi was examined in 1876 and 1879, but no close companion was visible: it may be remembered that at the epoch 1859·61 Secchi saw and measured the close star, and recorded it as "*bene separata*," and Otto Struve has measures of it in 1842, 1847, 1851, and 1876, those in the latter year corresponding almost precisely to the date of the Washington examinations, which seems to point to optical illusion, unless rapid variability is admitted. At the epoch 1879·77 δ Equulei was thought to be elongated at 150°, but Prof. Hall was not certain of its duplicity. Many of the more interesting binaries are included in this series of measures. The observations of the companion of Sirius made at Washington from 1866 to 1879 are given in a collective form, and we have observations of the faint stars near the annular nebula in Lyra, of which the following results possess value; *a* is the brightest of these stars and the one near the following end of the nebula; the angles and distances are referred to it except in the case of the companion of the triple star *f*, which are referred to *f* itself:—

		Pos.	Dist.	Magnitudes.
		°	″	
a and *b*	1877·582	225·50	93·90	10 and 14
a ,, *c*	1877·582	268·00	115·84	10 ,, 13–14
a ,, *d*	1877·592	286·90	138·58	10 ,, 12–13
a ,, *e*	1877·592	292·60	122·90	10 ,, 12
a ,, *f*	1877·582	313·70	101·79	10 ,, 13–14
a ,, *g*	1877·592	350·60	77·18	10 ,, 13
f ,, f_1	1877·592	253·30	3·96	13–14 ,, 13–14
f ,, f_2	1877·592	4·80	17·32	13–14 ,, 14–15

To connect the nebula with the stars the following estimates were made:—

(1) The right line *a* to *b* is 11″ outside of the nebula.
(2) ,, ,, *a* ,, *c* very nearly bisects the darker, interior part of the nebula.
(3) ,, ,, *a* ,, *f* is very nearly tangent to the nebula.
(4) ,, ,, *b* ,, *c* is nearly tangent to the nebula.

It is added that during these observations no star was seen inside the above ring of stars, nor any star within the nebula itself. Afterwards it was thought that a star was seen within the nebula, but Prof. Hall was not able to measure it.

GEOGRAPHICAL NOTES

THE twenty-third and twenty-fourth parts of the *Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens* contain an article by Dr. L. Döderlein on Oshima, one of the

largest of the chain of islands which runs from the south coast of Japan to the east coast of Formosa, and which include the Loochooan archipelago. The island has never before been visited by a European, and presents many features of scientific and general interest. Dr. Döderlein spent sixteen days there, during six of which he was kept indoors and in darkness by a violent typhoon, which is described in the twenty-third number of the *Transactions* of the same Society by Mr. Knipping of Tokio. Two distinct types of people were found in the island, one pure Japanese, the other—probably the original inhabitants before the Japanese conquest—are about the same size as Japanese, but somewhat better built. The face is not so broad, and grows smaller towards the bottom, so that the chin is pointed, a feature rarely found in the Japanese, whose chins are broad and round. The lips and nose are thin, the bridge of the latter being convex. The eyes are large like those of the people of Southern Europe. The most striking portion of the appearance of this people, however, is the thick hair which they have all over their bodies. In this respect they closely resemble the Ainos of Yezo and Saghalin. The language, of which some examples are given, is evidently a dialect of Japanese, half-way between the latter and Loochooan. The customs are in many respects different from those of Japan. The women tatoo themselves on the backs of the hands (the Aino women, it will be remembered, tatoo the lips) from the wrists to the roots of the nails. The marks are always the same, but no explanation of the custom could be given by the people. When a girl reaches the age of thirteen the operation is performed on her hands by people specially trained for the purpose. Married women never blacken the teeth, as in Japan. Although the population is about 50,000, there is neither priest nor temple in the island, and the people know nothing of a deity to whom they should pray. They pay a sort of veneration to their ancestors, but only to individuals, not to the progenitors of their race or tribe, as in Japan. Life would run very smoothly with the people, were it not for a poisonous snake, called *habu*, belonging to the Trimeresurus class. It attains a length of six or seven feet, and is equal in venom to the most poisonous snakes. The Japanese fear to land on the island on account of these reptiles, which are found everywhere. They are said to pursue eels in the streams, to climb trees easily, and even to do so for the purpose of attacking travellers more easily. At night no one will stir abroad, for the bite is invariably fatal unless assistance is immediately procured. In one place a village of thirty-one houses was abandoned because the *habu* were numerous in the neighbourhood. The only cure employed is excision of the part, or even of the limb, which has been bitten. The general conclusion at which Dr. Döderlein arrives is that Oshima belongs in its *fauna* to the Loochoos, and has but little connection in this respect with Japan. He thinks, therefore, that the boundary between two great zoological regions, the paleoarctic and the oriental, lies between the island and Japan.

In the last number of the *Proceedings* of the Berlin Geographical Society Dr. G. Fritsch has an extremely suggestive paper on geography and anthropology as mutual helpmates. The writer dwells upon the great aid each of these studies might derive from the sister science, if conducted in a broad and enlightened spirit. There are problems connected with the evolution of man and with his present distribution over the earth's surface, the solution of which depends upon a more exact knowledge of the former distribution of land and water, especially in the Tertiary period. The gap that separates man from any of the living anthropoids is profound; but it may possibly be bridged over or contracted to smaller proportions by the future discovery of fossil remains in the tropical regions, where the race most probably originated. Should these regions fail ultimately to yield the connecting links, then the conclusion would be strengthened that the evolution of mankind took place in some now submerged land, as, for instance, in the Lemuria of the Indian Ocean, or in the vast continent of which the Pacific islands may be regarded as the fragmentary remains. In the latter case the problem would remain practically insoluble, and the descent of men from some now extinct anthropoid forms would have to be regarded as at most an assumption incapable of strict demonstration. The present distribution of mankind, the writer goes on to point out, is largely bound up with more partial modifications of the earth's surface. A good instance is the Dravidian or aboriginal race of the Deccan, differentiated from the other types of the Asiatic mainland during the period that Southern India was still a triangular insular mass, before the now connecting Northern plains were created by the alluvia of the Indus and Ganges. From considerations of this sort Dr. Fritsch suggests a scheme of fundamental human types differing in some respects from any hitherto proposed by anthropologists, and insists especially on the necessity of separating the Koi-Koin (Hottentots and Bushmen) from the Negro proper. He also argues on similar grounds for the unity of the "homo Americanus," whom he refuses to regard as a mere branch of the Mongol or any other type of the Old World.

In a letter from Landana Père Carrie announces the arrival of Père Augouard's Stanley Pool expedition at Isangila on July 12. They were to resume their march for Manyanga on July 14, and hoped to reach it in eight days. Mr. Stanley is said to be hurrying on with his work in view of the expiry of his engagement with the International Association in March next.

The chance of obtaining news of the missing *Jeannette* exploring expedition before the winter closes in appears to be getting very remote. The revenue cutter *Thomas Corwin* has returned to San Francisco, and the steamer *Alliance* to Halifax, N.S., without any intelligence whatever of the party, and now we hear that the visit of the *Rodgers* to Wrangel Land has also been without result. Small boats belonging to the *Rodgers* circumnavigated Wrangel Land. The party in the boats also surveyed different parts of the island. The views from the top of the mountain on Wrangel Land disclosed sea all around it. The season had been most favourable for the purposes of exploration, owing to the openness of the navigation. The *Rodgers* would probably take up her winter quarters at St. Lawrence Bay, whence she expected to sail in June next, and proceed as far north as possible. Lieut. Berry finds that Wrangel Land is an island sixty miles in length.

The November number of *Petermann's Mittheilungen* is mostly occupied with two papers—On the Water-ways of France, by H. Keller; and on the Marsh Region of the Equatorial Nile System and its Grass Barriers. The latter is a paper of great value and interest, giving the results of the writer's observations during his recent terrible Nile journey. It is accompanied by a map of part of the Bahr el Abiad and Bahr el Seraf. There is also in the number a summary of the proceedings of the recent Venice Congress.

The Geographical Society at Bremen has received a telegram from the Brothers Krause, dated the 6th inst., announcing their safe arrival at San Francisco with good scientific and ethnographic collections. These explorers had visited the Chukchi Peninsula at various points, and intended spending the winter in the north of Alaska.

SCIENCE IN NEW SOUTH WALES

A GOODLY record of scientific work is furnished from time to time by our vigorous colonies on the Australian continent, where (as in other young countries), if the aids to science are not so complete as in some parts of Europe, the incitements to philosophical observation of natural phenomena are, for obvious reasons, peculiarly strong.

The *Journal and Proceedings* of the Royal Society of New South Wales for 1880, recently received by us, includes, with other matter, many valuable observations adding to a knowledge of the country. We gather that within the last quarter of a century, from natural decay, ring-barking, and clearing for cultivation, at least one half of the timbered land of the colony (it is estimated) has been denuded of trees. A very considerable diminution of rainfall might perhaps have been expected in consequence, but this has certainly not been the case; indeed statistics rather indicate the reverse. The principal rivers, too, have not been diminished in volume of water. Instructive in this connection is the experience of Mr. Abbott, with ring-barking of trees on his run at Glengarry. This operation (for improvement of grazing capacity) he carried out in 1869 and 1870, on most of the watershed of three creeks, each about two miles long, draining well-defined valleys shut in by high ridges of basalt. For twenty years previously these creeks were dry watercourses, only holding water for a few days after rain, and in a few places in winter. But soon after ring-barking they became, and have continued, permanent streams, with increased flow of water and number of springs. The explanation Mr. Abbott offers is that the large proportion of the rainfall formerly taken up by the gum-trees and evaporated, now finds its way to the creeks and rivers.

The records of thunder and hailstorms in New South Wales up to the end of 1878 were examined by Mr. H. C. Russell, with reference to the risk from hail to the Exhibition Building erected in 1879. The list is given in this volume. Mr. Russell could not trace any period in those storms, except that they seemed more numerous in the first year after a drought. They are not severe or numerous in wet years. The great number of storms when the earth is passing through the November meteor stream is noted.

The so-called salt-bushes of Australia are known to have properties that are of great advantage to sheep, which relish and fatten on the food, especially in times of drought. Mr. Dixon has analysed some eight of those fodders of the Riverina district, and shows, by comparison with well-known European fodders, that they stand well as to nutritive value. One is struck with the extraordinary amount of ash. In seven of the eight, the average ratios of total ash, potash, and common salt to digestible matter (oil, carbohydrates, and albuminoids), taken as 100, are 47, 9·538 and 7·689 respectively; and the difference here from European fodders is conspicuous. Cotton bush (the eighth examined) ranks with the latter. Only two contain a very large proportion of common salt, viz. oldman salt bush (the most prized by graziers), has 15·403, in the relation just specified, and small salt bush, 14·590. While digestion is doubtless promoted by the soluble chlorides, it is in the wool that the greatest effect of the diet (so rich in potash) might be expected, and the high esteem in which Riverina wool is held, is a verification of this.

Various kinds of coal of New South Wales have been subjected to analysis by Mr. Dixon and by Prof. Liversidge, the latter of whom specially wished to see how they compared with our coals. He found the Northern District coals to contain least ash, average percentage 4·61; those of the Western District have 10·44 per cent.; and those of the Southern 10·99. Thus some of the Northern coal is quite equal in this respect to the Welsh and Scotch coals, and but little inferior to the English Newcastle coal. The quantity of sulphur in New South Wales coal is by no means excessive. Prof. Liversidge also furnishes an account of some minerals from New Caledonia, including the nickel-bearing *Noumeaite*. This mineral seems to be completely amorphous; the mass splits up into smooth concave-convex pieces like petals of an unopened bud. It is in some cases soft and brittle, and in others hard and tough enough to be cut into ornaments. The colour varies from the palest tinge of green to full rich malachite green. The composition ranges from practically pure hydrated silicate of magnesia to what is also practically only hydrated silicate of nickel. The earthy cobalt ore (asbolite) from New Caledonia differs considerably from those met with in other places; baryta is entirely absent, but magnesia seems to have taken its place in some cases.

An interesting paper by Dr. Manning, medical superintendent of the Hospital of the Insane at Gladesville, treats of the causes of insanity in 3077 patients admitted to that institution in ten years from 1869; a comparison being also drawn with English statistics. We note that 3·9 per cent. of the cases of insanity are attributed to isolation and nostalgia conjointly (a category not given in the English table). The cases of pure nostalgia were those of foreigners, who spoke English most imperfectly. The cases of isolation included shepherds, whose occupation some years ago was most lonely, and still is, in some places, though the state of things is improving in this respect. Dr. Manning found last year that more than one half (1038 out of 2036) of the inmates of those institutions in the colony were apparently quite friendless, and that 10 per cent. were foreigners. The isolation, which is something terrible to a new emigrant, and which lasts often for years, is kept up by the disparity of the sexes, which at the close of 1879 stood at 409,665 males and 324,617 females, and it is fostered by the peculiar shifting and restless life of the miners and the bushmen. Dr. Manning thinks the insanity from intemperance has been exaggerated; the percentage at Gladesville is 8·3. The vile quality of the drink (he considers) and the system of drinking (short reckless outbursts, with prolonged periods of abstinence), are prominent factors in the result. Sunstroke, as might be supposed, causes insanity to a much greater extent in New South Wales than in England; 5 per cent. of the cases are accredited to it. Dr. Manning also expresses the opinion that insanity through lactation prolonged beyond the ordinary time is more frequent. Again, he is struck with the number of cases admitted with symptoms of dyspepsia and "chronic ill health," and he attributes a considerable number of those to the want of varied and properly cooked meals. As to hereditary transmission of insanity, the Gladesville statistics give only 7·2 per cent., but they are much less complete than the English, owing to the difficulty of getting to know the family history.

We can do no more than briefly indicate some of the other subjects dealt with in this volume; some new double stars, the longitude of Sydney Observatory, the opposition and magnitudes of Uranus and Jupiter, the orbit elements of Comet I. 1880, changes in the surface of Jupiter, catalogue of plants collected by Forrest in North-West Australia, fossil flora of Eastern Australia and Tasmania, piturie, iron acted on by sea-water, wood inclosed in basalt, fossils from Palæozoic rocks of New South Wales, schemes of water supply for Sydney, wells in the Liverpool plains.

ON THE APPLICATION OF PHOTOMETRY IN THE STUDY OF THE PHENOMENA OF DIFFUSION IN LIQUIDS

§ 1. SINCE the publication in 1803 of Berthollet's work,[1] in which it is already asserted that the diffusion of salt solutions in water takes place according to the same laws as the propagation of heat in solids, an exact method has frequently been sought for determining the coefficient of diffusion. The attempts in this direction have failed to give concordant results, which may best be judged from a compilation of the numbers expressible in absolute units with reference to chloride of sodium, whose coefficient of diffusion in water has most frequently been measured. The coefficient is stated to be—

By Graham, at 5° C.	88	
,, 9° C.	105	
By Fick	116	$\times 10^{-7}\cdot\frac{cm^2}{sec.}$
By Johannisjanz	53	
By Schuhmeister, at 10° C.	97	

When we inquire into the laws which govern this coefficient we meet with even greater discrepancies. Thus Graham, Fick, and Schuhmeister's researches indicate the increase of the coefficient with the rise of temperature. Johannisjanz finds no such relationship. Thus H. F. Weber, experimenting with sulphate of zinc, concludes that the coefficient of diffusion decreases with increase of concentration. Schuhmeister asserts exactly the contrary.

The importance which diffusion has gained of late as a means of investigating and solving many problems connected with molecular physics[2] induced me to search for a method which should permit me to investigate the processes of diffusion, not alone with more accuracy than heretofore in that direction in which the final results may be ascertained by simple weighing, but also to open up a new field of research which has been inaccessible up to now for want of suitable methods. A detailed description of my method, and a full account of all the circumstances to be observed in carrying out the experiments, will be found in *Wiedemann's Annalen*, vol. xiii. pp. 606–23. I will only give here the general outlines.

In the middle of a large glass trough a glass dish is inverted. On the top of this dish a narrow but thick glass rod is placed horizontally, and upon this four cylindrical vessels of approximately equal height at suitable distances from each other and from the walls of the trough. These are filled with solutions of the salt to be investigated, in such a way that the meniscus attains its maximum height. Water is now poured into the trough till it reaches in height 0·1 cm. below the edge of the shortest cylinder, and the whole allowed to stand for several hours to equalise the temperature. After this, by means of a specially constructed funnel, more water of exactly the same temperature as the water in the trough is introduced, until it reaches a height of several millimetres above the edge of the cylinders.

The apparatus is now left to itself.

To interrupt the experiment a method has been devised, the description of which will also be found in *Wiedemann's Annalen*.

The result is calculated by the formula—

$$D=\frac{l^2\pi}{4}\left(1-\frac{c_2}{c_1}\right)^2\cdot\frac{1}{t},$$

[1] Berthollet, "Essai de statique chimique," Paris, 1803, vol. ii., pp. 409–429.

[2] See Wroblewski, "On the Nature of the Absorption of Gases," in NATURE, vol. xxi. p. 190.

where signify

l the depth of the cylinder.

t the time of the experiment.

c_1 the concentration of the salt solution before the experiment.

c_2 the mean concentration of the solution after the experiment.

D the coefficient of diffusion.

§ 2.—Chloride of sodium was the substance experimented with to test the method. Three solutions were prepared, of which the first contained 0·66487, the second 5·8506, and the third 17·695 parts by weight of the anhydrous salt in 100 parts of the solution. The cylinders employed were 2 to 8 cm. in diameter, and 3·45 to 5·036 cm. in depth. The experiments were conducted either in such a way that all the cylinders were filled with the same solution, and the observation made if the cross-cut and the depth of the cylinder had influenced the final result; or else differently concentrated solutions were taken, and the experiment carried out at exactly the same temperature and under the same other conditions. The method was found to be sensitive and accurate. The temperature being 8·5° C., and the duration of the experiment 6·5 hours, the coefficient found was:—

With a solution of 0·66487 per cent.... 768
" " 5·8506 " ... 808
" " 17·695 " ... 889
} $\times 10^{-8}$ $\frac{cm^2}{sec.}$

The conclusion to be drawn from these numbers is that coefficient of diffusion within the limits of time and concentration indicated decreases according to the law of the straight line as the quantity of salt in solution.

From this result follow:—

1. The numerical value of the coefficient at the same temperature, and the same initial concentration depends upon the duration of the experiment.

2. A fixed state, in which the concentrations in the fluid decrease from bottom to top, according to the law of the straight line, is impossible. Fick's method, which presupposes this state, cannot therefore give correct results.

From the above-mentioned law of the dependence of the coefficient of diffusion on the quantity of salt in solution, and from the first conclusion, it follows that at one and the same temperature the value of the coefficient may vary between two widely separated limits. An experiment performed with a saturated solution during the shortest possible time would furnish the one limit, another with a solution containing a quantity of salt approximating to zero would give the other.

The physical cause and the necessity for the mentioned dependence is very simple. If a volume of water be mixed with one volume of concentrated salt-solution, and if a volume of water be mixed with a volume of dilute salt-solution, the resulting contraction in the first instance is greater than in the second. The diffusion of a salt-solution in water has been up to the present considered from a very one-sided point of view. Berthollet and Fick ascribe the diffusion to the forces alone which act between water and salt-solution; modern investigators ascribe it solely to the molecular velocity of the fluid molecules. The experiment shows that the diffusion depends on both, and therefore supports neither of these views entirely. When the cylinder has been filled with concentrated solution the participation of the molecular forces is greater than in the case of weak solution. The numerical value of the coefficient of diffusion, which expresses the result of the experiment, must necessarily be greater in the first case than in the latter. It is therefore in our power to regulate the phenomena of diffusion in a salt solution according to our will; thus when we experiment with concentrated solutions the principal agents at work are the molecular forces, whilst the velocity of the molecules plays the chief part in dilute solutions. The coefficient of diffusion of a salt-solution loses, therefore, entirely the signification of a constant, because in every special case it has another value.

§ 3. The coefficients of diffusion of salt solutions in water at the temperature of 10° C., determined by Graham, Fick, Weber, and Schuhmeister, form a group of numbers which lie between 0·000010 and 0·000002 $\frac{cm^2}{sec.}$.

It was of great interest to ascertain the value of the coefficient of diffusion when the quantity of salt is so small that it can neither be estimated with the balance nor with chemical means; when, in short, the solution differs hardly at all from pure water, and when the participation of molecular forces has been brought to a minimum. Such an experiment may be made by tinting water with a salt of great tinctorial power and observing the diffusion of the coloured water into the pure. It is much more difficult to follow these experiments quantitatively, as very small quantities have to be determined. Colorimetrical methods are not sensitive enough.

I therefore tried to measure the concentration photometrically. Nigrosin, which is sufficiently stable towards sunlight, was the colouring matter chosen for the purpose. Hüfner's spectro-photometer was employed. The water was coloured with nigrosin to such an extent that its coefficient of extinction for sodium light amounted to 1·343. The quantity of colouring matter used was so small that the change of specific gravity in the water through its addition could not be ascertained.

A full report of the many difficulties which were encountered and a detailed description of how the experiments were conducted will be found in the above-mentioned *Wiedemann's Annalen*. It was discovered that the coefficient of diffusion was smaller by one decimal place than the smallest known coefficient of a salt.

The method here described urges the investigation of a series of new problems.

In the first place the value of the coefficient must be ascertained for different salts when the salt in solution approximates zero. When these values have been found, only then it will be possible to define in what way the coefficient of diffusion depends on the nature of the salt.

Secondly, it is necessary to find out if it is not possible, by tinting water with different colouring-matters, to obtain a constant, which I propose—analogously to a case already considered by J. Clerk Maxwell—to call *the coefficient of diffusion of a fluid into itself*.

If we suppose a room to be divided into two parts by a movable wall and filled with the same gas at the same pressure and temperature, and we then remove the wall, a diffusion of the gas takes place from the one half of the room to the other, and *vice versâ*, in consequence of molecular velocity. The coefficient of the diffusion which takes place here, Maxwell calls *the coefficient of diffusion of a gas into itself*. It is not measurable, as the molecules of a gas cannot be marked. It can however be calculated from the coefficient of viscosity of this particular gas kinematically measured by multiplying by 1·5435.

When salt-solution diffuses, it is not the salt, but the salt-solution, which diffuses into water. The more dilute the solution, the nearer that state is approached in which pure water diffuses into pure water. How near I have approached this state in my experiments with nigrosin I have no means at present to judge. I have no doubt however that this is the only method of ascertaining the coefficient, which, if once determined in similar manner for every fluid, will be of eminent importance to a kinetic theory of fluids, which has yet to be built up. It is only necessary to bear in mind the assistance rendered to Maxwell by the determination of the coefficients of diffusion of gases by Loschmidt.

S. WROBLEWSKI

THE ROTATIONAL CO-EFFICIENT IN VARIOUS METALS

THE following is an abstract of a Note on the above subject read by Prof. E. H. Hall at the meeting of the British Association at York.

It was discovered two years ago in Johns Hopkins University that when a conductor carrying a current is placed in a magnetic field, the direction of whose force is perpendicular to the current, the current is deflected at right angles to the force and to the original direction of the current. A slip of gold leaf on glass was placed between the poles of Faraday's electro-magnet, with the faces of the gold-leaf perpendicular to the lines of force. Wires were attached one at each end of the strip, for the purpose of transmitting a current through it, and two other wires were led from the middle points of the sides of the strip to a Thomson's galvanometer. When the electro-magnet was not made this galvanometer showed no deflection, but on sending a current through the coil of the electro-magnet a deflection was obtained, and on reversing the direction of this current the deflection was reversed.

Dr. Hopkinson has pointed out that Maxwell, in the first part of his book, treating this subject in the most general way, allows the possibility that something of this kind may take place. Maxwell suggests the name "rotational coefficient"; so the

term which I employ is his, though the fact was not known to him.

I have published an article describing these experiments, which may be known to you, but I have since found some new facts. At Berlin I tested some metals which I had not tried before. I cannot vouch for the quantities within 50 per cent., but I think I can vouch for the direction of the effect. It is not the same for different metals under the same conditions of current and magnetic force. It might have been expected that the effect would be in the same direction in nickel as in iron; but it is not, it is in the opposite direction; nickel acts like gold, cobalt acts like iron. Nickel, silver, gold, platinum, and tin gave an effect opposite to iron.

The most important fact that I have to bring before you is that in zinc the effect is in the same direction as in iron and cobalt.

Table of effects on an arbitrary scale.

Iron	+ 78	Brass	− 1·3
Cobalt	+ 25	Platinum	− 2·4
Zinc	+ 15	Gold	− 6·8
Lead	—	Silver	− 8·6
Tin	+ 0·2	Copper	− 10
		Aluminium ...	− 50
		Magnesium ...	− 50
		Nickel	− 120

The deflection of the current in those marked + is in the same direction in which the conductor itself tends to move in the magnetic field. I cannot vouch for the order of the metals. I have tried three specimens of nickel, and the direction was the same in them all. One of them was pure nickel, furnished me by Prof. Chandler Roberts.

The following remarks were made by the chairman, Sir William Thomson:—

The subject of this communication is by far the greatest discovery that has been made in respect to the electric properties of metals since the times of Faraday—a discovery comparable with the greatest made by Faraday. I look upon it with special interest myself as so closely connected with electrodynamic properties of metals, which formed the subject of my Bakerian Lecture in 1856. I pointed out in that paper, in about § 104, that it was to be expected that magnetic induction would produce change of thermal conductivity and of electric conductivity in different directions in substances perfectly isotropic. I found by mathematical investigation rotational terms, and pointed out that we might expect in bodies which have rotational quality to find the effect of such terms exhibited. But the only influence having that relation to rotation which was necessary for producing the terms in question I pointed out to be the influence of a magnet, and that we might expect that the effect of a magnet upon an isotropic body would be to induce difference of quality in different directions in accordance with the rotatory term, and I said I thought it improbable that the rotatory terms would be found to be null in a body subjected to the influence of a magnet. I look with great delight on Prof. Hall's discovery, as having verified that which I predicted as probable. I did not myself make any serious attempt to discover it. It is the first illustration ever brought out by experiment of one of the most curious and interesting things in the mathematics of æolotropy. The previous mathematical writers dismissed these terms altogether, although they found them in the formula;—dismissed them as something which we could not imagine to exist. I refused to dismiss them, and said there was decided reason that they could exist under the rotational influence which we know to belong to a magnet.

Prof. Rowland said: Mr. Hall had tried the direction of rotation of the plane of polarisation when light is reflected from nickel and iron on Dr. Kerr's plan. The direction was found, if he remembered aright, to be in opposite directions for these two metals. We did not yet know enough to say whether this investigation explains the rotation of the plane of polarisation of light.

Prof. Sylvanus Thompson said he had verified Prof. Hall's result by using a telephone instead of a galvanometer.

Mr. Glazebrook said he had published a paper on the same subject in connection with the rotation of the plane of polarisation of light. Maxwell said this effect (rotation of the plane of polarisation by reflection from a magnet) could be explained by molecular rotation of the particles in the field.

Prof. Fitzgerald asked Sir William Thomson to express an opinion as to how it happens that different substances differ in the direction of this effect. He also remarked that the terms expressing the magnetic force on the matter were the same as those which would express Prof. Hall's observed effect on the current. Was the action to be regarded as an action on the matter or on the current?

Prof. Everett asked whether the current in its deflected condition was oblique (instead of, as usual, normal) to the equipotential surfaces?

Sir William Thomson, in reply, said that effect on matter and effect on the current through it went together, and could not be distinguished. He could not say why the effect in any particular metal was in one direction rather than the other. There was nothing in the mathematical theory to show in which metals it should be in the same direction. Prof. Everett's question might be answered by referring to several corresponding cases. If heat was flowing from end to end of a bar cut obliquely from a crystal, the points of equal temperature in two opposite sides would not in general be exactly opposite to each other. The foundation of the general theory of which this was an illustration had been laid by Prof. Stokes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—On November 3 Sir William Anson, Bart., D.C.L., Fellow and Sub-Warden, was elected Warden of All Souls' College in succession to Dr. Leighton, deceased. Sir William Anson was Vinerian Reader in English Law.

A Fellowship at University College will be offered for competition about the end of next February. The examination will be in biology and kindred subjects. At the last examination for a Biological Fellowship none of the candidates were judged of sufficient merit, and the election was accordingly deferred.

Candidates for the Brackenbury Natural Science Scholarship at Balliol College must communicate with the Master by letter on or before Friday, November 11. Papers will be set in Chemistry, Mechanics and Physics, and in Biology. There will also be an optional paper in Mathematics, and an essay.

At Christ Church there will be one or more Natural Science Junior Studentships elected next March. Candidates must not have exceeded the age of twenty on January 1, 1882. Papers will be set in Chemistry, Biology, and Physics, but no candidate will be allowed to offer himself in more than two of these subjects.

CAMBRIDGE.—On Monday, November 7, Mr. J. E. Marr, F.G.S., was elected to a Fellowship at St. John's College. In 1878 Mr. Marr obtained a First Class in the Natural Sciences Tripos; in 1879 he received a grant from the University to enable him to travel in Bohemia and study the Cambrian and Silurian rocks there; also in 1880 he went in a similar manner to Norway and Sweden. His paper on the Rocks of Bohemia was published in the *Quarterly Journal* of the Geological Society for November 1880. He is at present lecturing for the University at Barrow Kendal, and Lancaster.

GLASGOW.—Mr. John Macalister Dodds, B.A., Fellow of St. Peter's College, Cambridge, 4th Wrangler, 1880, has been appointed one of the assistants to Dr. Jack, Professor of Mathematics in the University of Glasgow. Mr. Dodds was a distinguished Glasgow student before proceeding to Cambridge. All the four Professors of Mathematics and Natural Philosophy in the Universities of Edinburgh and Glasgow—Prof. Tait, Prof. Chrystal, Prof. Sir William Thomson, and Prof. Jack—are Peterhouse men.

SCIENTIFIC SERIALS

The American Naturalist for September and October, 1881, contains (No. 9, vol. xv.): Carl F. Gessler, variations in a copepod crustacean (woodcuts).—A. S. Packard, jun., Scolopendrella and its position in nature (places Symphyla as a suborder of Thysanura).—W. H. Dall, American work in the department of recent mollusca in 1880.—D. G. Brinton, notes on the Codex Troano and Maya chronology.

No. 10, vol. xv.: D. H. Campbell, on the development of the stomata of Tradescantia and Indian corn (woodcuts).—Cyrus Thomas, the age of the manuscript Troano.—J. Walter Fewkes, the Physophoridæ (iii.).—R. E. Cull, the Loess in Central Iowa.—A. S. Packard, jun., on the early stages of the

fiddler crab and of Alpheus.—Hartley Barnes, Reason: a psychological distinction.

Bulletin de l'Académie Royale des Sciences de Belgique, No. 8.—Palæontological documents relating to the Cambrian formation of Ardenne, by M. Malaise.—Magic square of the Villa Albani (Rome), by M. Catalan.—On the specific weight of sulphur of Ch. Saint-Claire Deville, by M. Spring.—On the dilatation of sulphur, selenium, and tellurium, by the same.—On the rotatory power of albumen of a dog's blood, by M. Fredericq.—Latitude on a voyage; graphic process, by M. Adan.—On the monazite of the quarries of Nil, St. Vincent, by M. Renard.—Description of a new and precise registering barometer, by M. Delaey.

Journal de Physique, October.—Determination of the wavelengths of the very refrangible radiations of magnesium, cadmium, zinc, and aluminium, by M. Cornu.—Researches on the refringent power of liquids (continued), by M. Damien.—Experimental researches on the capacity of voltaic polarisation (concluded), by M. Blondlot.—Measurement of the energy expended by an electric apparatus, by M. Potier.—Experiment in optics, by M. Dubois.

La Natura, October.—On the thermal radiation and the temperature of the sun, by S. Cattaneo.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiv. fasc. xv.—Discussion of some mistakes regarding American vines, by Count Trevisan.—Alteration of muscular fibres in a case of locomotor ataxy, by Prof. Golgi.—On photoparæsthesia in insane persons, by Dr. Raggi.—On variations in the velocity of the arterial current following paralysis of the vagus nerve, by Prof. Solera.—Anomaly in a parrot (*Psittacus Amazonicus*, Lin.), by Prof. Maggi.—Elimination of nitrogen from tyrosine, by Prof. Körner and Dr. Menozzi.—On some products of transformation of chinoline, by Prof. Körner.

Rivista Scientifico-Industriale, September 30.—The axis of rotation of Mercury, by T. Zona.—A compressed air bell-rheometer, by S. Scardona.

Rendiconti delle Sessioni dell'Accademia delle Scienze dell' Istituto di Bologna, 1880-81.—We note here the following:—On the internal discharges of condensers, by E. Villari.—Adaptation of species to their environment; new observations on the genetic history of Trematodes, by G. Ercolani.—On the mode of termination of nerve-fibres in the cornea, and the internal construction of the axis-cylinder, by G. V. Ciaccio.—Anthropometric researches on the Bolognese, by G. Peli.—Chemico-toxicological researches on a putrefied brain, by C. Stroppa and G. Tomani.—Morphological, anatomical, and organic researches on the various species of the genus Citrus, by G. Cugini.—On the course of the river Po, and on works which must be undertaken in presence of danger which threatens the neighbouring population, by P. Predieri.—New method of obtaining pure gastric juice and determining its physiological properties, by L. Vella.—Electric shadows, by A. Righi.—On defective births in the females of *Myoxus glis*, and in the human species, by G. B. Ercolani.—On the ovulation of *Distoma hepaticum* and *lanceolatum* in sheep and oxen, by G. B. Ercolani.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 3.—Dr. Gilbert in the chair.—The following papers were read:—On citraconic and mesaconic ethers and malic and fumaric acids, by W. H. Perkin. The author has carefully investigated the physical properties of the methylic and ethylic ethers of citra- and mesaconic acids. Dr. Gladstone has also measured their refractive indices. The citraconic ethers boil at a higher temperature than the mesaconic ethers, but their specific gravities, magnetic rotatory power, and refractive indices are lower. Only one anhydride can be obtained from maleic and fumaric acids, one from citra- and mesaconic acids, and one from α and β coumaric acids. Maleic anhydride can be obtained directly from malic acid by heating with an excess of acetylic chloride.—On the action of potassium cyanide on bismuthous nitrate, by M. M. P. Muir. A puce-coloured body is formed, $Bi_7(CN)_6O_{15}$; by heating with strong potash Bi_4O_7 is obtained.—On the atomic weight of bismuth, by M. M. P. Muir. The author has analysed bismuthous chloride, and obtained as a mean atmospheric weight 210·46, but he is not satisfied with the results, and hopes to obtain better numbers by the synthesis of bismuthous iodide.—Additional observations on the halogen salts of bismuth, by M. M. P. Muir.—Note on the action of sulphuric acid on zinc and tin, by M. M. P. Muir and C. E. Robbs.—On the volumetric estimation of bismuth in the form of oxalate, by M. M. P. Muir and C. E. Robbs.—Note on the influence of water on the reaction between potassium iodide and chlorine, by M. M. P. Muir and R. Threlfall.—Laboratory notes, by M. M. P. Muir. 1. Lecture experiment showing the effect of "*a*" time, "*b*" temperature, "*c*" mass. This consists in adding a solution of bismuth iodide in hydriodic acid to each of three beakers, one containing 100 cc. of cold water, 100 cc. of hot water, and 500 cc. of cold water. 2. The solution of manganese dioxide and manganese ores in hydrochloric acid is much hastened by potassium iodide. 3. A new method of detecting tin in the presence of antimony: by boiling with metallic copper and testing for stannous salt with mercuric chloride. 4. To detect the haloid acids in presence of nitrous and nitric acids.—On suberone, by R. S. Dale and C. Schorlemmer.—On sulphonic acids derived from isodinaphthyl, by Watson Smith and T. Takamatsu.—On phenylnaphthalene, by Watson Smith and T. Takamatsu.—On dimethylmalonic acid and dimethylbarbituric acid, by L. T. Thorne. The author confirms the conclusions arrived at by Conrad and Guthzeit.

PARIS

Academy of Sciences, October 31.—M. Wurtz in the chair.—On account of the death of M. Bouillaud the *séance* was adjourned.—*Comptes rendus* for the week contains—Observations of Cruls' comet (*b* 1881) at Marseilles Observatory, by M. Stephan.—Elliptic elements of the same comet, by M. Bossert.—Observations of comets *c* 1881 (Schäberle), *d* 1881 (Encke), *e* 1881 (Barnard), *f* 1881 (Denning), at Paris Observatory, by M. Bigourdan.

VIENNA

Imperial Academy of Sciences, October 20.—V. Burg in the chair.—L. E. Tiefenbacher, on the forest and its relations to landslips (a supplement to a work by the same author, on landslips, their causes, effects, and treatment).—F. Austerlitz, a contribution to the ballistic problem.—E. Mahler, theory of curvature of an *n*-fold manifoldness.—E. Weiss, computation of the elements and ephemeris of Barnard's comet (continued).

GÖTTINGEN

Royal Society of Sciences, June 4.—Absolute measurement of the strength of terrestrial magnetism by a galvanic method without determination of time, by F. Kohlrausch.—Theory of curves of double curvature, by A. Enneper.—Remarks on some transformations of surfaces, by the same.

August 6.—Lycopodin, by K. Bædeker.

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