THURSDAY, SEPTEMBER 1, 1898.

MORPHOLOGY OF VERTEBRATES.

Elements of the Comparative Anatomy of Vertebrates. Adapted from the German of Dr. Robert Wiedersheim by W. N. Parker, Ph.D. Second edition. Pp. xvi + 488. (London: Macmillan and Co., Ltd., 1897.)

ELEVEN years have elapsed since we had occasion to review in these pages the first English edition of Prof. Wiedersheim's "Elements of the Comparative Anatomy of Vertebrates," adapted and modified from the first German edition by Prof. W. N. Parker. During this interval zoology, like every other branch of science, has been making steady progress, with the almost necessary result that theories and views which were held only a few years ago, have with increased knowledge become untenable or required modification. Prof. Wiedersheim has accordingly had on two occasions to bring up his text-book to date by the issue of new editions; not that in the earlier editions extreme views were set forth which have had to be abandoned, but simply to keep pace with the natural growth of knowledge of the forms of animal life. It is not before it was necessary that a second English edition has been undertaken if the work was to maintain its place amongst our comparative anatomy manuals of the day.

It happens in most cases where further editions are called for, that the author of the original work in his subsequent issues not only brings them up to date, but also considerably enlarges the modest dimensions of his first edition by the introduction of new matter. This has been the case with Prof. Wiedersheim's book, and in preparing the work now under review, Prof. Parker has had to select between the alternative of making a translation of a greatly enlarged German edition, and consequently modifying the scope of the new English edition, thereby bringing it into competition with the larger works on the subject already in the field and within the reach of English students, or of adapting Prof. Wiedersheim's latest text, and thus maintaining the original character of the English edition, which has proved to have a distinct sphere of usefulness to the English student. Prof. Parker has, we think, been well advised in adopting the latter alternative. But, notwithstanding his attempt to keep down the size of the new English edition, it contains 143 pages more than the first edition. This is not, however, all additional text, because in the present edition the bibliography of the subject has received considerably more additions to it than any other part, and instead of being a short list of the principal monographs placed after each section throughout the work, and when taken together occupying not more than nine pages, it now forms an appendix of 92 pages at the end of the book. Although no one appreciates more than we do the advantages of a good bibliography, we consider that in a work like this under review, which deals only with the elements of the subject, such a bibliography is entirely superfluous and useless. While it would have been a useful feature in a text-book of comparative anatomy of vertebrates to which one would naturally go for references, it is quite out of place in a work essentially for junior students. Prof. Parker would, therefore, have been much better advised to have kept this portion well within the limits of the space assigned to it in his earlier edition. When the portion of the book just referred to is left out of account, the text proper shows an increase of little over 60 pages. Some of these are occupied by new and additional illustrations, which are distinctly useful and an improvement. As examples selected at random, we may mention the new diagram inserted on p. 219, showing the shifting of the lachrymal gland which has taken place in the course of phylogeny, that on p. 240, of the development of a tooth, and those illustrating the anatomy of the organs of generation. There are also several new illustrations which replace older and less perfect ones, amongst which may be noticed those illustrating the anatomy of amphioxus, on p. 274, and the respiratory apparatus in fishes, on p. 277. The number of illustrations is a marked and useful feature of the work, and the manner in which they have been executed by the publishers is very commendable, as they show a great improvement on those usually met with in English text-books.

The arrangement of the text corresponds with that adopted in the earlier edition, and begins with a general introduction, in which the meaning and scope of comparative anatomy, the development, structural plan of the vertebrate body, the main classification of the principal vertebrate groups, and their gradual development in geological deposits, and therefore in time are briefly explained. The comparative anatomy of the various organ-systems is next described in the following order: the integument, the skeleton, the muscles and electric organs, the nervous system and sense organs, the organs of nutrition, respiration, circulation, excretion, and reproduction, beginning in each case with those of the lower forms of vertebrates and working up to the higher. A glance at the first page is sufficient to show the correctness, as regards it, of Prof. Parker's statement in his preface to this edition, that much of the book has been entirely re-written; and this we have been able to confirm, from examination of subsequent pages, is the case throughout. He has also been at some pains to make the treatment of the different sections more approximately equal, and to deal with well-ascertained and essential facts rather than take up space with doubtful theories and special details. Hence we find that the views associated with the name of Prof. Wiedersheim as to the derivation of the limbs of higher vertebrates from the fins of fishes have been judiciously omitted in this edition, and the theories of Gegenbaur and others are not referred to, presumably for the same reason. When the morphological significance of a part is doubtful it is, we consider, far better to state so openly, as has been done regarding the derivation of the diaphragm, where, after mentioning its morphology in vertebrates generally, the author concludes with the following remark: "The evolution of the mammalian diaphragm is not yet thoroughly understood."

The section of the comparative anatomy of the brain and nervous system is considerably improved in the new edition, both in the text and the illustrations. The description of the suprarenal bodies no longer poses between the description of the sympathetic nervous system and the sensory organs, but is relegated to the end of the genito-urinary system until something more is known about them.

From this brief sketch it will be gathered that the author has considerably improved the work in most respects; but we regret to see the terms *epi* and *hypo* still used in describing the embryonic layers, instead of the prefixes *endo* and *ecto* used by German zoologists, which are greatly preferable, especially in teaching students. We would have liked also to have seen less clarendon type used in the text and restricted to headings only, also the retention of the German system of emphasising words and passages by means of double spacing between the letters of the type.

Doubtless the new edition of the "Elements of Comparative Anatomy of Vertebrates" will continue, and that deservedly, to retain its place amongst students' manuals. J. G. G.

ANIMAL PLAY.

The Play of Animals; a Study of Animal Life and Instinct. By Karl Groos. Translated by Elizabeth J. Baldwin; with a Preface and Appendix by J. Mark Baldwin. Pp. xxvi + 341. (London: Chapman and Hall, Ltd., 1898.)

THIS interesting little work, the preface to the original German edition of which is dated 1895, presents one very unusual peculiarity. The editor, with the author's approval, has acted the part of the candid friend, and in his preface has given not only a valuable synopsis of the chief contents and object of the book, but has added such careful criticisms on the author's theories as to render further critical observations almost superfluous, Prof. Baldwin being a well-known authority on subjects akin to those treated by Prof. Groos.

Not only is the book practically unique in its subject, but it appeals to two distinct classes of readers. In the first, second, and fifth chapters it appeals to the philosophical student of animal play as a serious subject; while the third and fourth chapters are devoted to actual illustrations of this play, and, as charmingly written and authentic anecdotes, will delight a much wider circle. Indeed, to both classes of readers the work may be commended with every confidence.

The author takes, so to speak, a very serious view of the importance of play in animal development, and treats it with the profundity of research characteristic of the German investigator. He says, for instance (p. 291), that

"it seems a very mistaken proceeding to characterise play as aimless activity, carried on simply for its own sake. Energetic action may be provocative of pleasure, but it is by no means the only source of the pleasure produced by play."

And the view that play is a veritable instinct is elaborated with great wealth of detail in the second chapter. Here, as the editor remarks, we have full details of such interesting topics as imitation in its relation to play, the inheritance of acquired characters in relation to the rise of instincts, and the plan and function of intelligence in the origin of these primary animal activities. And here, perhaps, the humanitarian may derive a mitigated satisfaction from the theory (pp. 121 and 122) that the cat's treatment of the captured mouse is not due to the love of torture for torture's sake, but is owing to an instinctive exercise for acquiring skill in the chase, turned later into practical account by the captor.

The first chapter is an examination of Mr. Herbert Spencer's theory of the "surplus-energy" origin of play, which, if we accept the author's views, must for the future be put aside. Chapter ii., which deals with the biological theory of play, must be read in connection with Chapter v., of which the physiology of play forms the subject; these three chapters, as already stated, supplying the theoretical and philosophical matter of the book, while the two intermediate chapters afford the detailed facts on which the superstructure rests.

Some of the author's main theoretical positions are concisely summarised in the following extract from his editor's preface:—

"He holds play to be an instinct developed by natural selection, . . . and to be on a level with the other instincts which are developed for their utility. It is very near, in its origin and function, to the instinct of imitation, but yet they are distinct. . . . Its utility is in the main twofold. First, it enables the young animal to exercise himself beforehand in the strenuous and necessary functions of its life, and so to be ready for their onset; and, second, it enables the animal by general instinct to do many things in a playful way, and so to learn for itself much that would otherwise have to be inherited in the form of special instincts; this puts a premium on intelligence, which thus comes to replace instinct. Either of these utilities, Prof. Groos thinks, would ensure and justify the play instinct; so important are they, that he suggests that the real meaning of infancy is that there may be time for play."

For the difficulty the editor sees in this conception of play as a pure instinct, the reader must be referred to the work itself, which is long likely to maintain the leading position in a new and important field of inquiry.

The data on which the author relies as his basis for theorising are necessarily in great part drawn from the writings of others. In the selection of these he appears to have exercised a wise discrimination. His great obligations to Brehm's "Tierleben" are fully acknowledged, and we are glad to see that he accepts all the observations of Mr. W. H. Hudson, some of which we believe there has elsewhere been a tendency to discredit. In the main the animals referred to are rightly named, but we shall be surprised if the creatures termed "badgers" on p. 113 of the translation are not really ratels. R. L.

OUR BOOK SHELF.

The Study of Man. By Alfred C. Haddon. Pp. xxxi + 512. (London: Bliss, Sands, and Co. New York: C. P. Putnam's Sons, 1898.)

THE publication of this volume will doubtless be the means of exciting interest in anthropological inquiries, and adding to the number of scientific students of human-kind. The work is not a systematic treatise on anthropology, but a collection of articles upon various subjects of anthropological study, containing much that is interesting to the serious student, for whose benefit numerous references are given to original papers, and written in a style which should prove attractive to every intelligent reader.

After an introductory account of the scope and aims of anthropology, Prof. Haddon describes the usual anthropological measurements, and then surveys such features as the colour of the hair and eyes, the form of the head, and the character of the nose, drawing instructive conclusions from the facts as to the distribution of these characteristics. To illustrate the value of blending anthropological investigations with the records of history, he devotes a short chapter to an abstract of Dr. Collignon's work on the ethnography of the Dordogne district of West Central France. Following this are two interesting chapters on the evolution of the cart, and the origin of the Irish jaunting car, which latter conveyance Prof. Haddon shows was evolved at the end of the last century, or more probably within the first few years of this century. A series of popular articles on the history and literature of toys and games are used as the basis of the succeeding eight chapters, the chapter on "bull-roarers" being particularly noteworthy. Finally, instructions are given for conducting ethnographical investigations, based upon those issued by the British Association Committee on the Ethnographical Survey of the United Kingdom. It will be understood from this outline that Prof. Haddon's work, which, we may add, is illustrated by a number of good figures, will interest the public in anthropological science, and thus assist in the preservation of vanishing knowledge.

A School Geography. By George Bird, B.A., F.G.S. Pp. x + 294. (London: Whittaker and Co., 1898.)

THIS volume is distinctly in advance of the usual schoolbooks of geography; for it belongs to the steadily increasing class of works which aim at making the study of scientific subjects educative as well as informing. The long lists of capes, rivers, mountains, &c., which still frequently figure in school geographies, and have to be committed to memory by the unfortunate pupils of teachers behind the times, have been omitted, and instead of pages of unnecessary statistics we have a logical statement based upon a rational scheme of geographical teaching. In the author's words: "While trying to make the book interesting, I have also tried to make it of educational value by continually referring to the influence of the geographical position and surroundings upon the climate, productions, industries, and trade of the various countries."

Every geographer admits that these are the right lines to follow, but opinions differ as to the amount of astronomical geography which should be studied before the pupil passes to the description of the various countries. Mr. Bird commences with a chapter on astronomical geography, and then deals in successive chapters with land, water, air and climate, before passing to general geography. With the exception of the first chapter, these introductory descriptions will be easily understood by the pupils of about twelve or thirteen years of age, for whom the book is intended. Teachers of geography know how very difficult it is to give young pupils clear and accurate ideas concerning the movements of the earth and the phenomena produced by these motions, and many of them will probably take Mr. Bird's hint to touch but lightly upon topics in the opening chapter in going through the book for the first time. If more prominence had been given to apparent phenomena, which the pupils can observe for themselves, and less to the actual conditions which produce them, this chapter would have gained in educational value. But this is a minor point, and the book as a whole represents a creditable attempt to improve the teaching of geography in this country.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Case of Inherited Instinct.

THREE species of cave locusts are found in New Zealand, belonging to three different genera. (1) *Pachyrhamma speluncæ* is allied to *Gymnoplectron longipes*, which lives among the branches of trees, both genera being known only from the north island. (2) *Pleioplectron edwardsii* inhabits caves in the south island, and has close allies, belonging to the same genus, living amongst old wood in both islands. (3) *Macropathus filifer* is allied to *Pharmacus montanus*, which lives in the open among rocks, both genera being from the south island. *Macropathus* and *Pleioplectron* may have originated from a common ancestor in New Zealand, but *Pachyrhamma* belongs to another section, and is more nearly related to European and American species than to the other cave locusts of New Zealand. These three genera belong to that group of the *Stenopelmatidæ*—distinguished by having no pads on the tarsi—to which all the cave locusts of North America, Europe, and Burma belong; the habit of living in caves appearing to be an instinct found only in that group among the whole of the *Locustodea*.

So much for the facts: now for the inference. We cannot suppose that the ancestors of the New Zealand cave locusts, who migrated to that country through what is now called the Malay Archipelago, lived in caves during the whole of the migration; partly from the impossibility of their having passed from one cave to another, and partly because each species has allies which do not live in caves. If this be so, we have here a most interesting case of an instinct which has not only been transmitted through many generations, but which must, in at least two cases, have remained dormant during the greater part of the southerly migration, and reappeared when favourable conditions enabled it to do so. For we are compelled to assume that none of the first *Stenopelmatidæ* which came to New Zealand lived in caves, and that some of the descendants of the northern cave locusts reverted to that curious mode of life.

F. W. HUTTON.

Christchurch, N.Z., July 20.

Transference of Heat in Cooled Metal.

YOUR issue of June 30, containing a letter from M. Henry Bourget under the above heading, has only just come into my hands. In 1889, when working at the Cavendish Laboratory, Cambridge, I was interested in the phenomenon described by M. Bourget, and made a few preliminary experiments in connection therewith, but, owing to other work, I was unable to proceed very far with the investigation, and probably shall not have the opportunity of doing anything further. My notes, taken at the time, show that the following experiments were made and results obtained:—A large well-used soldering bolt had a hole drilled nearly through the iron shank at the end remote from the copper portion; into this hole, and surrounded with mercury, was placed the bulb of a thermometer with small thermal capacity; a bunsen flame was then placed beneath the copper portion, and the heating continued until the thermometer indicated a steady temperature. The flame was then removed, and a vessel containing water brought up over the hot end, upon which the thermometer showed a rise of 1·5° C. There was a considerable film of copper and iron oxides, &c., at the junction of the iron and copper.

After this a copper rod ⅜ inch diameter and 18 inches long, and with a bend of about 45°, 4 inches from one end; at the end of the 14" portion, close to but just not touching, was placed a sensitive thermopile connected up to a low-resistance reflecting galvanometer. The rod was set up with the longer portion horizontal, and the 4-inch portion depending. The end of the rod and the thermopile were well shielded by means of asbestos and dusters, and the rod passed tightly through a hole in a large vertical sheet of asbestos millboard in order to protect the thermopile further from any chance currents of heated air or steam.

As before, a bunsen flame was placed at the centre of the depending portion of the rod, and when the galvanometer spot showed that the temperature gradient along the rod had become steady, the galvanometer was adjusted to false zero; the flame was then removed, and after waiting a second or so until the spot was beginning to move in the cooling direction, a vessel of water was brought up over the hot end, the galvanometer spot *at once* moved nearly across the scale in a direction indicating a rise in temperature. Further experiments seemed to show that this heating effect was greater when the temperature of the heated end was sufficiently high to produce the spheroidal state; when this was not the case, the movement of the spot in the cooling direction was decreased or altogether stopped, but no increase in temperature was indicated. With the copper rod arranged as described, no perceptible movement of the spot in the heating direction took place until about thirty seconds after the application of the bunsen flame. An attempt was made to see if an opposite effect could be obtained when a heated metal sleeve was slid over the 4″ portion, but nothing definite was observed. In connection with the apparently instantaneous manifestation of a rise of temperature at the cooler end of the bar following the cooling of the hotter end, other experiments suggested themselves. For although the experiments described were only preliminary and somewhat rough and ready, yet I think it was established by them that the velocity of transmission of the effect is very much higher than that of heat by ordinary conduction or convection. The objects of the further experiments were to find out, if possible, to what the effect is due and what is its mode of propagation. In order to ascertain if the effect could be obtained in liquids, a piece of thin weldless steel tube, closed at one end and about 9 inches long, was filled with mercury and the bulb of a thermometer was just submerged beneath the mercury. On experimenting in the manner already described a very slight heating effect was observed, which might nave been due to a sudden cooling of the glass bulb, and no definite results were obtained. Here the writer had to drop the investigation.

When a heated sphere is plunged into water, a rise of temperature in the inner portion might take place owing to the work done on it by the cooled and contracting envelope, but in the case of the copper rod this does not seem a sufficient explanation.

If, as I hope, some of your readers undertake to investigate this very interesting phenomenon, I would be pleased, if it be of any service, to give them particulars of the experiments I had proposed carrying out, but for which, unfortunately, I have neither time nor opportunity. Albert T. Bartlett.

Old Charlton, S.E., August 22.

The Use of Digraphs.

If all writers, or, better still, all printers followed the rule of Mr. Horace Hart, and never permitted the use of æ and œ, but always spelled them out ae and oe, many happy results would ensue. Authors would cease to confuse editors and printers with undecipherable attempts to represent a diphthong; 5 per cent. of the misprints that have to be corrected in technical biological papers would disappear; zoological names, if no others, might at last be written correctly, and the student no longer confused with *coelatus* when *caelatus* was meant, and so forth. There need be no confusion with those rare words in which the vowels are distinct, since the custom of printing "aërated," "oölogy," and the like already prevails. If the only evil in sight is that Mr. Montagu Browne will feel impelled to the exceedingly unnecessary task of rewriting his museum labels, by all means let us entreat the printers to reform. F. A. Bather.

Natural History Museum.

THE APPROACHING MEETING OF THE BRITISH ASSOCIATION AT BRISTOL.

The Excursions.

In a district so rich in geological and antiquarian, as well as industrial, interest as that of which Bristol forms the centre, it is to be expected that the excursions will form an attractive feature of the approaching meeting. A brief synopsis will serve to indicate some of the salient points of the varied programme.

Taking first the Saturday excursions, that (1) to Bath will occupy the whole day and will include the Roman Baths and Remains, the Moore Museum (geological), the valuable collection of local antiquities at the Institution, and the fine Abbey Church. Geologists will have an opportunity of visiting sections of White Lias and Rhætic, under the guidance of the Rev. H. H. Winwood. In the afternoon the party will drive to Claverton Down and Manor, returning by Widcombe and Beechen Cliff, where a bird's-eye view of Bath is obtained. Another whole-day excursion (2) includes the Severn Tunnel, with its pumping apparatus of fourteen engines on the Cornish type capable of lifting eighty million gallons per diem; Chepstow Castle, which still retains some of the original eleventh century masonry and an Early English chapel; the Chepstow railway bridge, in which the tubular and suspension principles are combined, and the Severn Bridge with its swing-bridge weighing about 400 tons. A half-day excursion (3) is arranged to Aust Cliff, which presents a section of great interest to geologists. This will be examined with Mr. H. Pentecost of Clifton College as guide. It is hoped that enough of the Rhætic bone-bed, with its rich store of saurian and fish remains (including the teeth of *Ceratodus*) may be brought down to the beach to give the geologists of the party an opportunity of securing good specimens. This excursion also includes a visit to Over Court and Knowle Park. Another half-day excursion (4) is to Stanton Drew with its striking megalithic remains, including three stone circles, two "avenues," a dolmen (if such it be), and several outlying stones included in the scheme of construction. Prof. Lloyd Morgan will here be guide. The drive also includes Sutton Court, the residence of Sir Edward Strachey, and, if the weather be clear, Dundry Hill, whence a fine and extensive view, comprising scenic features of formations from the Old Red Sandstone to the Chalk, is obtained. Those who are interested in docks, lairage, chill-rooms, and granaries, may devote the afternoon to Avonmouth (5) and see, under the guidance of Messrs. Girdlestone and McCurrich, the floating pontoon dock and cold storage installation. Those for whom architecture has stronger attractions will perhaps select either Raglan Castle and Tintern Abbey (6), to which the whole day will be devoted, or Bradford-on-Avon (7), with its unique and perfect little Saxon Church of St. Lawrence, its quaint old Town Bridge, its fourteenth century Tithe Barn, and its residential houses, including that in which Dr. John Beddoe, F.R.S., now resides. Those, again, who seek an impressive lesson in physical geology and the origin of scenery, may drive from Yatton to Cheddar (8), through the Vale of Wrington, and Burrington Combe, over the arched dome of Mendip, and beneath the splendid mural bastions of Carboniferous Limestone in the Cheddar gorge, visiting the interesting stalactitic caves near the little village of Cheddar. While those who wish to see one of the best examples of an ancient dry-walled camp, with a number of curious pits, probably for storage of grain, in which skeletons with ugly gaps in their dolicho-cephalic skulls have been found, may take the afternoon excursion to Weston-super-Mare and Worlebury.

On Thursday, as on Saturday, there is a wide range of choice. One party will have an opportunity of driving to the Barrow reservoirs and Chelvey pumping station of the Bristol Water Works (10). The supply of water comes from springs on the Mendip Hills, about sixteen miles from Bristol, from others at Barrow Gurney, and wells at Chelvey, near Nailsea. The storage reservoirs at Barrow Gurney have a water-area of about 130 acres, and extensive filter-beds. At Chelvey there are pumping engines of the rotary beam type, with single and compound cylinders, variable expansion, surface and jet condensers, and bucket and plunger pumps. The aggregate horse-power is 660. Another party will visit Wells and Glastonbury (11). Apart from the architectural and historic interest of these places there is the special attraction of the marsh-village, which will be visited under the guidance of Mr. Arthur Bulleid, whose name is so intimately associated with its discovery. On the edge of the ancient (but now reclaimed) meres stood a village consisting of about seventy dwelling-mounds covering some 3½ acres. The foundation of the village is composed of layers of timber and brushwood resting on the peat, and is surrounded by a palisade. On the wood circular areas of clay are spread, and on these wattle huts were erected, the clay forming the floor of the dwelling. A number of interesting relics of the old British community who dwelt there are preserved in the little museum at Glastonbury. The excursion to Stroud and Nailsworth (12) combines a visit to an industrial district of considerable importance, and a drive through some of the finest scenery of the Cotteswold district. At the Stanley and the Dudbridge Mills all the processes of making raw wool into the finest plain and fancy coloured materials can be seen, and the best and most improved textile machinery can be inspected. Sir W. H. Marling, Bart., gives in the guide-book a concise history of the industry in the district. Minchinhampton Common, with its so-called "pit-dwellings" and ancient encampments, Nailsworth, Woodchester Park, Uleybury and Frocester Court are included in this excursion. The excursion to Swindon Works, Marlborough and Savernake (13), again combines industrial processes and scenery, while the inspection of Marlborough College, and its mound, will no doubt prove an additional attraction; while that to Frome, Longleat, and Shearwater (14), combines a visit to the Art Metal Works of Messrs. Singer and Sons; an inspection of the residence of the Marquis of Bath, built in the middle of the sixteenth century, on the site of an Augustinian Priory, and containing a fine collection of pictures; and a charming bit of Wiltshire scenery. The excursion to Bowood and Avebury (15) affords, besides a visit to the residence of the Marquis of Lansdowne, with its pictures and mementoes of the owner's sojourn in India and Canada, an opportunity of seeing the megalithic remains and enclosing earth-bank and ditch (the latter on the *inner* side) at Avebury, and the huge mound, 126 feet high, of Silbury. The moat or fosse surrounding this hill has been silted up by fine detrital matter from the Kennet. Avebury Church, with its Saxon work, Norman work, twelfth century font, and later fifteenth century rood-loft, is of considerable interest and most picturesquely situated. Salisbury, Stonehenge, and Old Sarum (16), including the Blackmore Museum in Salisbury, open up, in one long day, a perhaps unparalleled range of historic and prehistoric retrospect; while for those who seek the yet earlier records of geological times the excursion to Tortworth (17), by special invitation of Earl Ducie, is of special interest. Strata of Silurian age, with remarkable beds of trap-rock in the Upper Llandovery series, quarries in Old Red Sandstone and Carboniferous Limestone, and pits for the winning of Celestine (sulphate of strontium) in the Keuper beds, provide a sufficiently varied geological bill of fare. The approach to Tortworth Court, through a picturesque, well-wooded valley in the Carboniferous Limestone, occupied by an artificial lake, is remarkably beautiful. Some of the Silurian quarries have been specially opened up by Earl Ducie. Prof. Lloyd Morgan has written the guide to the excursion, and Mr. Edward Wethered will describe the micro-organisms which occur in the limestones.

At the close of the meeting a long excursion (18), specially arranged for our colonial and foreign visitors, will comprise Exeter, Torquay (including Kents Cavern), Dartmouth, Plymouth, Mount Edgcumbe, Devonport, and a trip across Dartmoor.

For all these excursions guide-books have been prepared by the leaders and those specially acquainted with the localities. And it need hardly be added that, largely through the courteous hospitality of many hosts, corporate and private, there will be no lack of refreshment by the way.

THE BERLIN GEOGRAPHICAL SOCIETY'S GREENLAND-EXPEDITION.[1]

IN 1891 Dr. Drygalski and Herr Baschin visited Greenland under the auspices of the Geographical Society of Berlin, and the results they obtained were so interesting and suggestive that the Society was encouraged to despatch another expedition in the following year. On this second and longer visit Dr. Drygalski was accompanied by Dr. E. Vanhöffen as zoologist, and Dr. Hermann Stade as meteorologist. They left Copenhagen on May 1, 1892, and returned on October 14, 1893. The principal object of the expedition being the study of the ice of Greenland, it was desirable that selection should be made of some region in which both the "inland ice" and the independent glaciers of the west coast mountain-tracts could be conveniently examined. On the advice of those experts, Dr. K. J. V. Steenstrup and the late Dr. Rink, Dr. Drygalski proceeded to the region of the Umanak Fiord, which he found admirably suited for his purpose. There the land lying between the margin of the "inland ice" and the coast attains its greatest width, and the mountains nourish a number of independent glaciers. Broad areas over which the "inland ice" had formerly passed could be traversed with ease, and the terminal edge of the ice was readily examined. Again the numerous branches of the fiord, penetrating the territory occupied by the ice-sheet, are invaded by great tongues protruded from the latter, so that the calving of icebergs and other phenomena could be closely studied. That Dr. Drygalski would make good use of his opportunities was only to be expected, and the elaborate monograph he has produced is unquestionably a most important contribution to our knowledge of the physics of ice and glacial action.

The author, we need hardly say, finds himself unable to agree with Dr. Rink, who believed that the "inland ice" is essentially a product of the low grounds—that it originated in the valleys by the freezing of the streams and rivers, and thus gradually increased from below upwards, until eventually it overtopped the water-sheds and covered the whole land. Dr. Drygalski takes the generally accepted view that the "inland ice" had its origin in the mountains, descending from these at first in the form of separate glaciers which gradually coalesced, and so filled up the valleys and smothered height after height until the whole land disappeared. Rink's notion appears to have been suggested to him by the structure of the ice, which he thought was rather like that of lake- or river-ice than snow-ice. But Dr. Drygalski shows that this is not the case. According to his observations river-ice and snow-ice have the same structure. He is inclined also to dissent from Dr. Nansen who, as is well known, holds that the general form of the great ice-sheet is independent of that of the underlying land-surface—and that the ice-shed need not coincide at all with the buried water-shed. Dr. Drygalski, on the contrary, is of opinion that the ice-shed is determined by the presence of a mountain-range, supposed by him to be connected with the mountains of the east coast, and to extend in a parallel direction between them and the centre of the

[1] "Grönland-Expedition der Gesellschaft für Erdkunde zu Berlin, 1891-93," unter Leitung von Erich von Drygalski. 2 vols. royal 8vo; with 53 plates, 10 maps, and 85 illustrations in the text. Pp. 556 and 571. (Berlin: W. H. Kühl, 1897.)

country. Dr. Nansen, however, might reply that, after all, the existence of this mountain-range is problematical, and that neither in Scandinavia nor the British Islands did the ice-shed and the height of land coincide. Thus, in the north of Ireland the ice-shed of Pleistocene times lay over the central low grounds, while in the north-west of Scotland it occurred east of the water-shed, and the same in a more marked degree was the case in Scandinavia.

Turning to the much-discussed subject of glacier motion, we find that Dr. Drygalski comes to the conclusion that movement is the result of variations in the mass of the ice. Numerous observations and measurements demonstrated that there is both a vertical and a horizontal movement in the "inland ice," the former being the primary movement of the two. Over the marginal zone he observed a well-marked bulging of the surface, while further inland, where the ice is thicker, the surface appears relatively depressed—a condition sometimes obscured, however, by the heaping-up of snow. These differences in the configuration of the ice-sheet are due to variations of mass within the ice, the sinking or depression being the result of internal shrinkage, which is always greatest at the bottom, and progressively diminishes upwards. Had the whole mass shrunk in the same proportion as the ice at the bottom, the sinking at the surface would have been more pronounced.

The stratified or bedded structure of the ice has the same tale to tell. That structure is the result of the freezing of water under pressure, and since the individual layers diminish in thickness from below upwards, while the cold at the same time increases, it is clear that the internal shrinkage under which refreezing takes place must likewise lessen towards the surface. It is evident, indeed, that the layers must become thinner upwards, seeing that the pressure necessary for their formation diminishes in that direction. Melting, no doubt, does take place at the surface, and the released water trickling downwards is again frozen, but stratification does not result from this process. It is at lower levels in the ice that the structure is developed. And as water cannot possibly filter down from the surface through a compact ice-mass, the obvious conclusion is that the water necessary for the production of the structure in question originates within the "inland ice" as the result of pressure. The presence of stratification, then, shows that liquefaction and re-solidification take place in the "inland ice." But the water set free under pressure cannot, as a rule, refreeze in exactly the same place, otherwise it would be difficult to account for vertical movement in the ice.

Depression of the surface indicates a diminution, and bulging of the surface an increase in the volume of the ice. Under the weight of the overlying mass material is squeezed out from the thicker into the adjacent thinner portion of the ice. In short, an outflow takes place, and will continue as long as a sufficient degree of melting is kept up in the former, and the same degree of mobility is not attained in the latter. The ice-sheet, therefore, moves from the interior, where it is thickest, to the marginal area, where it is thinnest. And observation showed that under these conditions it could move up slopes.

Dr. Drygalski points out that many complications arise from the varying distribution of heat in the ice-masses, and from other causes which need not be referred to here. He found that the temperature of the thinner ice of the marginal area was generally lower than that of the thicker ice stretching inland. In the latter the ice is at, or nearly at, the melting-point. There is thus again a tendency to movement from the interior outwards. Water is forced from the thicker into the thinner masses, but, because of the low temperature of the latter, it quickly freezes, and thus gives rise to the formation of new ice-layers. The abundant presence of stratification in the thinner ice of the marginal area shows that this process is very active there, while the bulging of the surface proves that the bedded structure is intimately connected with increase of volume.

Sometimes the horizontal movement is so pronounced as to obscure the vertical movement more or less completely. In other places only the latter may be noticeable. The rate of the former depends on the thickness of the ice and the intensity of the vertical movement. The greater these are the more rapid it becomes. In the independent glaciers of the coastal tracts it was found that the rate of motion diminished as the rock débris included in the ice increased in quantity. This was to have been expected, since the mass of the ice, and therefore the whole thickness of the glacier, diminished at the same time. In the longitudinal section of such a glacier the rate of motion lessens towards the end, but with the "inland ice" the reverse is the case—it increases. In the former the ice loses bulk absolutely owing to ablation at the surface, and relatively because of the inclusion of rock-rubbish. But the great ice-streams that flow from the interior into the deep fiords increase in thickness towards the end. In glaciers and "inland ice" alike the horizontal movement of the surface depends upon that of the lowest layers. At Asakak, for example, the horizontal movement at the bottom was measured and compared with that of the surface, and this proved to be less than it ought to have been if all the layers of like thickness between the bottom and the surface had been moving at the same rate. The differential movement of the individual layers, therefore, decreases from below upwards.

The movement at the surface of a great ice-stream coming from the "inland ice" increases towards the end. Were it not for the rapid movement of its lower layers, therefore, the ice-flow would lose its continuity. When the ice enters the sea, it eventually reaches a point where the pressure of the mass itself no longer affects the lower layers—the primary vertical and secondary movements cease, the squeezing-out process comes to an end, and true glacier motion is succeeded by the purely passive movement of the iceberg.

In his discussion of the mechanics of glacier motion, Dr. Drygalski, as will be seen, upholds the well-known theory of Prof. James Thomson. He points out how the water set free under pressure is transfused into air vesicles, cracks, &c., in the ice, where it freezes again, so that the ice eventually becomes clearer. As this process goes on most rapidly at the greatest depths, the ice at the bottom is necessarily the clearest—clearness, in short, increases from the surface downwards. Further, since refreezing takes place under pressure, the ice crystals arrange themselves with their chief optic axes perpendicular to the lamination or bedding of the ice. As a result of these changes, the volume of the ice is diminished—the shrinkage being greater in the thick than the thin layers, and more marked in the inland tracts than in the marginal area of the ice-sheet. But we need not follow the author further into this part of his discussion. When he states that the horizontal motion depends upon the movement of water within the ice, he will not be misunderstood. He does not mean free flowing streams of water, but mechanical changes in the mass and transference of conditions. Perhaps also it may be as well to add that, although measurements prove that differential movement of the ice-layers increases from the surface to the bottom, it is not to be supposed that one layer flows out from under the layer above it. There is a certain loosening of the connection between them, the author remarks, but not an actual separation. In consequence of this some of the motion of the lowest layer is added to that of the next above, the rate of which is thereby increased. And so the process continues from layer to layer up to the surface, the motion of which is not the sum of the differential movements of all the underlying layers, but of part of the same. The surface as a whole, therefore, has the greatest motion, although the proper motion of the superficial stratum itself is the least of all.

Helmholtz would appear to have been the first physicist abroad to recognise the significance of Thomson's theory, and he set forth its application in such a form as could not fail to attract attention. Since the publication of his "Populäre Wissenschaftliche Vorträge," however, so much has been written on the subject of glacier motion—so many conflicting explanations and criticisms have appeared—that laymen may be excused if they confess to a feeling of confusion in regard to the whole question. We feel sure, therefore, that Dr. Drygalski's work will be welcomed not by physicists only, but by all who desire to have clear views on the subject with which it deals. They will find in its pages excellent descriptions and illustrations of the varied glacial phenomena, so that even those who may not quite agree with some of his conclusions will yet thank the author for the abundant data he has supplied.

To geologists, not the least interesting portions of Dr. Drygalski's work are those that deal with glacial action. He shows that the conclusion reached by them as to the former existence of a great ice-sheet in Northern Europe is justified, and that the conditions under which they believe the "diluvium" was accumulated are reproduced in Greenland at the present time. In Europe the ice-sheet occupied the basin of the Baltic, its source being in the lofty heights of Scandinavia to the north-west, and its termination in the regions lying south and east—regions that slope up to heights of several hundred metres and more above the bottom of the Baltic basin. In Greenland the "inland ice" fills the depression between the mountains of the east and west coasts, the former of which constitute a broad belt of high ground that possibly extends into the very heart of the country. This mountain-tract is the source of the "inland ice," the terminal front of the latter thinning off upon the slopes of the less elevated mountains of the west coast. The numerous deep fiords by which that coast is indented, penetrate to the inland depression, and into these, therefore, enormous ice-streams make their way. To the great fiord-glaciers of Greenland there was nothing analogous along the southern and eastern margins of the old "inland ice" of Northern Europe. Between the fiords of Greenland, however, the ice-sheet thins out upon the mountain slopes in the same way as the European *mer de glace* must have done upon the flanks of the Riesengebirge and other ranges of Middle Germany.

The smoothed and striated surfaces observed underneath the edge of the "inland ice," and in the areas from which it has retired, exactly recall those of Europe. Their origin, Dr. Drygalski remarks, is not hard to understand when we remember that the chief work of ice-movement is carried on at the bottom, where the relative motion is greatest. The bottom-layers of the ice are crowded with rock-débris, which under glaciostatic pressure is carried from areas where the ice is thickest to regions where it is thinnest, and in this way it often travels from lower to higher levels. Armed with this material, the "inland ice" is a most effective agent of erosion. As the included material increases in quantity, the relative thickness of the ice is correspondingly diminished, and thus changes in the direction of ice-movement must take place. Hence erratics, after travelling for some distance in some particular direction, may change their course again and again. And so in like manner divergent striæ may be engraved upon the rock-head over which the ice is moving. The varying configuration of the land-surface is thus not the only cause of changes in the direction of ice-flow.

The author is convinced that "inland ice" is quite capable of producing the contortion and disturbance which so frequently characterise the diluvial deposits of North Germany. Powerful pushing and shoving are effected by the horizontal movement of the lowest layers of an ice-sheet. Any water-saturated deposits underlying such a mass would be influenced in the same way and subjected to the same disturbance as the débris-laden portions of the ice itself. Where the ice is free from inclusions the internal changes which result in horizontal movement are not interfered with—the ice-layers remain undisturbed. But when débris is present the movements due to pressure are hindered and impeded, and the ice-layers amongst which it lies become bent and folded. In alluvial or similar deposits underlying the ice folding would be still more readily produced, since in their case pressure is no longer relieved, as in the ice, by transference of conditions, but is entirely converted into mechanical deformation.

The "inland ice" where it thins off upon the flanks of the west coast mountains is bordered by moraines. These are composed of materials derived from the bottom of the ice-sheet, and are continually being added to; the moraines, in short, are gradually heaped up at and underneath the thin edge of the ice-sheet. In other places where the ice is bordered by precipitous land no moraines are extruded, the steep rock-declivities causing a deflection of the ice-flow. The moraines, according to Drygalski, present the same appearances as the "end-moraines" of North Germany. Although for the most part unstratified, they yet now and again consist in part of water-arranged materials. Scratched and polished stones were common. It is clear, indeed, from the author's descriptions that the morainic matter extruded from the "inland ice" of Greenland has essentially the same character as our boulder-clays.

Dr. Drygalski draws attention to the interesting fact that not only in the marginal tracts of the "inland ice," but in certain independent glaciers the "blue bands," which are the result of pressure, trend in the general direction of ice-movement. This shows that there must be pressure in the direction of the high grounds overlooking the ice, and perpendicular to the trend of ice-flow. The author thinks it probable, therefore, that under these conditions subglacial morainic materials might well be heaped up in banks and ridges having a direction parallel to that of glacial movement.

With regard to the ground-moraine itself, there can be no question that this is partly carried in the lower portions of the ice, and partly pushed forward underneath, and, further, that the forward movement must result in the deformation of underlying unconsolidated formations. The moving force is, of course, in the ice itself. With the augmentation of included débris the mobility of the mass is impaired, internal friction increasing the more closely the materials are crowded together. It is only when débris is well-saturated that under pressure movements like those of the ice itself can take place. In a compact subglacial mass of débris the movement communicated by the flowing ice above must, owing to friction, quickly die out downwards. Only a relatively thin layer of ground-moraine, therefore, can travel onwards underneath the ice. Immense quantities of material, however, are interstratified with the lower layers of the "inland ice," and these are eventually added to the ground-moraine. The amount of this included or intraglacial débris depends upon the thickness of the ice, and must thus vary from place to place As the ice diminishes in thickness, its ability to transport rock-materials declines, and the rubbish begins to be deposited below. Dr. Drygalski thinks that the boulder-clays of North Germany were in all probability deposited in this way. Thus wide sheets of boulder-clay and the "end-moraines" of a great ice-sheet have had the same origin—they consist of ground-moraine accumulated under the thinner peripheral portions of the ice.

According to the author there is no doubt that the action of the ice favours the formation of rock-basins. Should a depression or hollow occur underneath an ice-sheet, and the ice be thicker in the hollow than over the adjacent tracts, the hollow will tend to be progressively excavated. He thinks, however, that the erosive work of the ice will tend rather to the lengthening of the hollow in the direction of glacial movement than to its deepening. Wherever the ice is thickest there erosion will be most pronounced, no matter what the form of the land-surface may be. Thus rock-basins may be hollowed out even in relatively flat land, as, for example, by a glacier upon the low ground opposite the mouth of a mountain valley.

Such are a few of the many interesting points connected with glacial action which are discussed by Dr. Drygalski. He concludes his work by some very suggestive remarks on the wonderful resemblances that obtain between the old gneiss-formation and the "inland ice"—the oldest and the youngest *Erstarrungsprodukte* of the earth's crust. When he had surveyed the steep gneiss-walls of the fiords, with their folded, contorted and confused bedding, their bands of crystalline schist, their veins and dykes, their fissures and fractures, he was astonished to encounter the same appearances in the "inland ice," and he follows the analogy into minute details of structure. But enough has been said to show that Dr. Drygalski's monograph is of no ordinary interest to geologists.

The chief object of the expedition being the study of ice in general and of the movement of the "inland ice" in particular, the opportunities for biological investigation did not at first appear to be very promising to Dr. Vanhöffen. But in this he was happily disappointed, for he succeeded in bringing home much material for study. His contribution to the work before us occupies the greater portion of the second volume. In this he does not confine himself to a mere description of his own investigations and their results, but gives us an exhaustive account of the fauna and flora of Greenland, including of course the life of the adjacent seas. For the benefit of those who are not specialists he illustrates his work with a number of beautiful coloured plates of some of the crustaceans, pteropods and jelly-fish which swarm in the waters of the far north. A copious bibliography is appended—great pains, indeed, have been taken to give a complete survey of the natural history of Greenland. A more special and detailed account of his own investigations is to appear in the *Bibliotheca Zoologica* and *Bibliotheca Botanica* (Stuttgart).

The concluding part of the second volume is devoted to the discussion of the magnetic, meteorological, astronomical and geodetic work of the expedition by Drs. Stade, Drygalski, and Schumann. Dr. Stade devotes a chapter to the föhn winds of West Greenland, which have long puzzled navigators and excited the superstitious fears of the Eskimo. Coming as these warm winds generally do from the ice-covered land, especially in the coldest time of the year, they seem hard to account for. According to Dr. Stade they owe their origin to depressions passing through Davis Strait from south to north. The approach of a depression is marked by strong to stormy winds from the south-east or east, the temperature of the atmosphere suddenly rising, while at the same time its relative humidity is reduced.

Altogether this most recent of Arctic expeditions has been fruitful in results, and the Geographical Society of Berlin must be congratulated on the great success which has attended the enterprise. JAMES GEIKIE.

THE PRODUCTION AND USES OF OZONE.

THOUGH it has been known for more than a century that air and oxygen acquire a peculiar odour when exposed to the action of electric sparks, and though Schönbein ascertained nearly half a century ago that this odour is due to a distinct form of matter, now called ozone, which is produced by the electrolysis of dilute sulphuric acid, by the action of electric discharge in air, and as a product of the slow oxidation of phosphorus, chemists are still trying to learn the exact conditions of the formation of this substance, and still investigating some of its simplest reactions; whilst inventors are but beginning the work of making it useful to man.

But if the wheels of science grind slowly, in the end they grind true, and various facts now distinctly suggest that ere long ozone will play a useful part in the service of medicine, of surgery, and in the arts.

Ozone has never yet been obtained as a gas in the pure state, but from the properties of mixtures containing it we cannot doubt that gaseous ozone would be blue in colour, and condense at low temperatures to an indigo-blue liquid, which explodes violently on contact with olefiant gas. The ozone in mixtures, such as are produced by the electrification of air or oxygen, is very instable, being resolved into common oxygen with explosive violence if suddenly compressed without previous cooling; and even under atmospheric pressure it cannot long be preserved except at rather low temperatures. This characteristic instability of ozone is at once the cause of its most interesting properties and of its possible usefulness. Molecules of common oxygen contain but two atoms of the element, whilst the molecules of ozone contain three such atoms, and it would seem that the atoms hold together much less firmly in the larger molecules than when they are united in pairs; consequently ozone acts as a powerful oxidiser, readily giving up part of its oxygen to oxidisable substances, whilst the rest returns to the ordinary form of the element, except in certain cases when it is completely absorbed.

Now chemists have, it is true, plenty of powerful oxidisers at their command, and many of them are inexpensive; but not even hydrogen peroxide, which can now be obtained comparatively cheaply, is quite so simple in its action as ozone, for this substance, which consists, as we have seen, of oxygen and of oxygen alone, when used as an oxidiser does not leave any inconvenient residue, such as accompany the action of many other oxidising agents. Hence a field for the employment of ozone may be found whenever a simple oxidising agent is required. Thus, for example, it has been suggested that it might conveniently be used for bleaching beeswax, starch or bones, in the manufacture of *dégras* for leather makers, in preparing drying oils for the manufacturers of varnishes, or again, according to Wiedermann, to hasten the ageing of whiskey.

There are, however, as might be expected, difficulties to be surmounted. Sometimes, as in its action as a bleaching agent, ozone is apt to act too slowly; whilst at others it is difficult to adjust the proper dose of the oxidiser. Thus we are told that port wine treated with ozone forms a deposit which quickly increases, so that the wine soon puts on an appearance which, under ordinary circumstances, it would only acquire in the course of years. But, alas! wine thus rapidly ripened is apt to fade with corresponding rapidity, owing, it is presumed, to the use of too much ozone, and hence, in the absence of any obvious method of estimating the proper dose, ozone does not yet recommend itself to wine makers or wine merchants. It has occurred to the writer, however, that it might possibly be made useful, even at the present stage, in judging unripened wine, since its use might enable the vintner to ascertain without delay how the wine of a given vintage will ultimately turn out. Unfortunately the experiment has not yet been tried, owing to the difficulty of finding a suitable colleague.

At a recent discussion on ozone at a meeting of the Society of Chemical Industry, the general opinion seemed to be that whilst there are, doubtless, possibilities of usefulness for ozone, nothing has yet been done which is likely to induce manufacturers to invest much capital in plant for its production; it is therefore interesting to learn that successful attempts have already been made to employ this interesting substance in medicine. It has long been known that ozonised air acts as a preservative of flesh, preventing and arresting putrefaction; and the simplicity of its mode of action, already alluded to, has naturally suggested its great suitability for use as an oxidiser and antiseptic in medical practice. Therefore one hears, without surprise, from those who have tried it, that in ozone we have an agent which is likely to be of real value in the treatment of diseases which are associated with the existence of organisms, or where the use of an oxidiser is indicated; for example, in the treatment of phthisis, of unhealthy wounds, and of some cases of anæmia, and for purifying the air of dwelling rooms, hospitals and public buildings.

But before ozone can play a really important part in the above or other directions, the earlier modes of making it must be improved upon, and its production cheapened.

Ozone, as has already been said, was first noticed in air which had been exposed to the sparks of electrical machines; but only very small quantities can be obtained in this way, and it is better to expose the air to a sort of electric rain composed of showers of very fine sparks, such as were employed by Andrews, or to the so-called silent discharge in one of the various forms of the "Siemens' induction tube." This in its simplest form consists of a long thin test-tube sealed at its open end into a slightly larger tube, the latter being provided with a narrow tube at each end, so that a current of gas may be passed between the two test-tubes. If the inner tube of such an apparatus be filled with dilute sulphuric acid and connected with one of the electrodes of an electrical machine, and if the outer tube be plunged in a bath of dilute acid which is connected with the other electrode of the machine, whilst air or oxygen is passed through the apparatus, a glow or a shower of fine sparks will act on the gas, and charge it more or less strongly with ozone ere it escapes.

Ozonisers such as the above have been employed in many of the chief researches on ozone, and probably give the best results when small or moderate volumes of oxygen are to be dealt with, but for work on the large scale this form of ozoniser does not give equal satisfaction. For such work it has been proposed to replace the glass tubes by sheets of glass coated with tinfoil or silvered; whilst recently a new departure has been made by Mr. Andreoli, who replaces one of the plane or curved electrodes by a conductor carrying numerous points. For manufacturing purposes Mr. Andreoli recommends the use of serrated grids made of aluminium, and carrying as many as 17,760 points on every grid. Each grid is placed opposite a sheet of aluminium with a sheet of glass interposed, the whole being bound together by wooden clamps (see Fig. 1). It is claimed that with such an arrangement of suitable dimensions, 10 kilos. of ozone can be produced at the small cost of thirteen shillings and fourpence. As the air and apparatus employed are not cooled, the charges of ozone are probably not very strong, but for many purposes this does not seem to be a matter of great importance. A more serious objection to the system lies in the fact that the employment of metallic point bearing grids seems not unlikely to favour the production of comparatively large sparks which, if they should occur, would undoubtedly cause the formation of

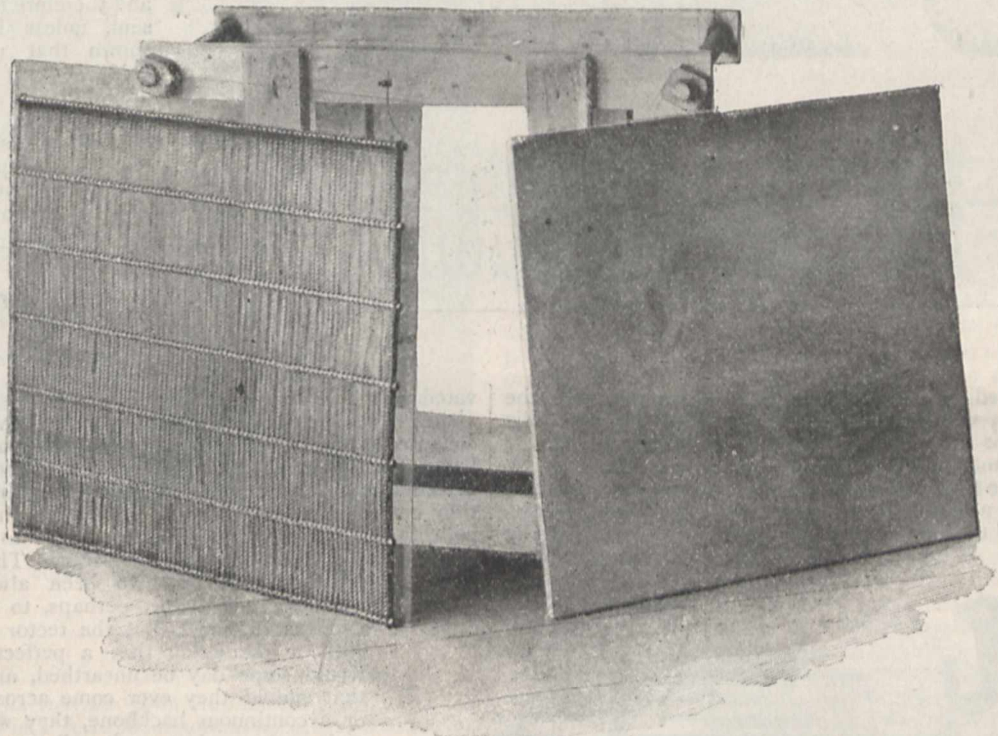


FIG. 1.

nitric peroxide. Now this gas, besides often being objectionable on its own account, would undoubtedly tend to reduce the yield of ozone. Mr. Andreoli does not, however, admit that nitric peroxide is formed in his apparatus, and if further experience should support his contention it would seem that he has really effected a substantial improvement.

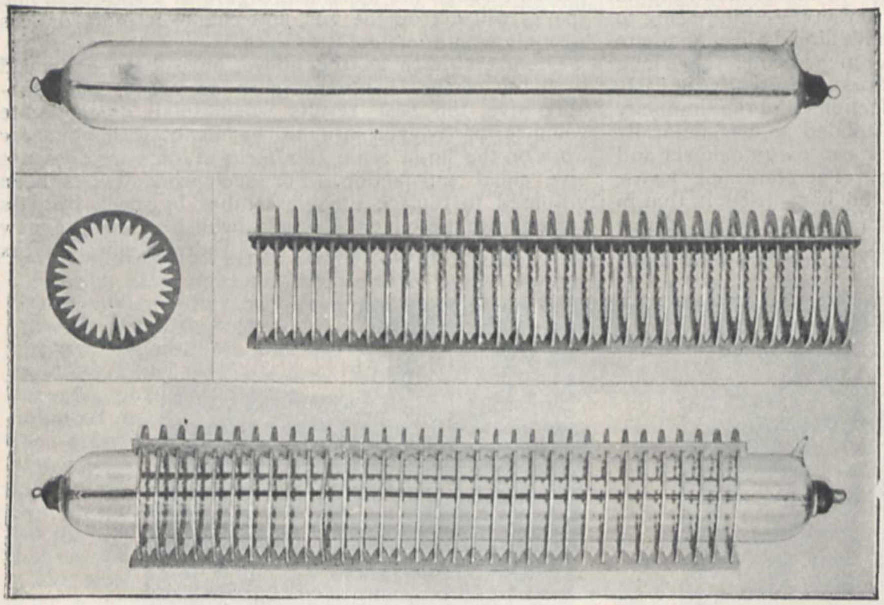


FIG. 2.

For medical purposes the new apparatus takes the form of a vacuum tube (I, Fig. 2), containing a metallic rod. This is surrounded by an armature (II and III, Fig. 2), made of aluminium and armed with points. When the latter and the metallic rod are joined up to a coil or to a step-up transformer a glow makes its appearance, and the air between the two electrodes is rapidly ozonised. If a stream of ozonised air is required for inhalation, or must be conveyed to any particular locality, the above little apparatus is surrounded by a glass jacket, as shown in Fig. 3.

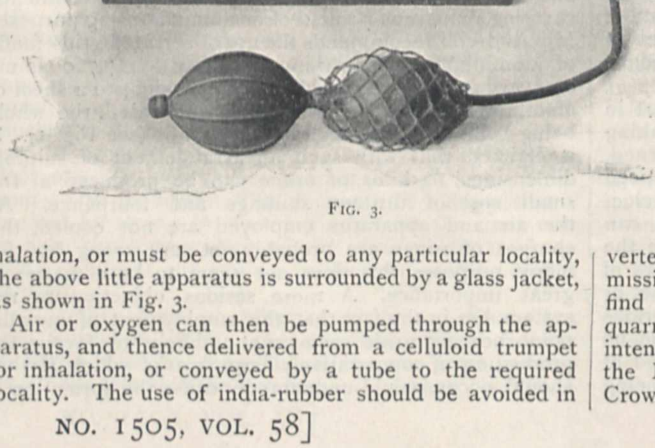


FIG. 3.

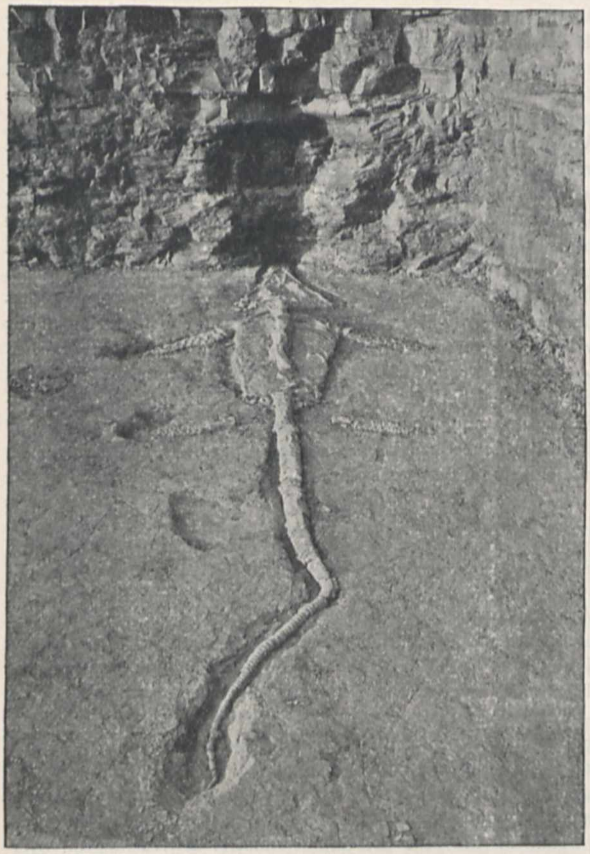
Air or oxygen can then be pumped through the apparatus, and thence delivered from a celluloid trumpet for inhalation, or conveyed by a tube to the required locality. The use of india-rubber should be avoided in this part of the apparatus, as india-rubber perishes with astonishing rapidity when exposed to the action of ozone.

It seems often to be supposed by inventors and others, that air and oxygen may be employed indifferently as sources of ozone. This, however, is not really the case. If moderately pure oxygen be used, nitrous fumes are far less likely to be formed than when air is employed; and this is so not only in the event of large sparks passing in the ozoniser, but also when the gas is subjected to the influence of the silent discharge. Unfortunately we do not yet know the exact conditions under which the silent discharge induces the formation of nitric peroxide, though the subject is being investigated; and therefore for the present, unless it can be shown that nitric peroxide is itself beneficial, or, at least, quite unobjectionable, ozone for medical use should certainly be prepared from oxygen whenever it is possible to do so.

A DRAGON OF THE PRIME.

THE little Warwickshire village of Stockton, ploughed and excavated by three manufacturing cement firms, has long yielded to collectors choice specimens of Lower Middle Lias fossils. Its late rector educated the quarrymen by lectures and in conversation to understand and value the vertebræ and belemnites and limas and encrinites which they continually disinterred, forming with their help a collection which on his departure went to form the nucleus of a County Council museum. The Saurian remains have hitherto been always fragmentary, a fact due, perhaps, to the men's careless digging; but the rector left them with a prediction that a perfect monster would some day be unearthed, an entreaty that should they ever come across a head or a continuous backbone, they would drop pick and crowbar, and call in experts to direct and continue the search. A week or two ago the prediction was fulfilled, and the advice remembered. The wielder of a pickaxe suddenly announced that he was "grapplin' along a lot of backbones"; the work was stopped, the foreman summoned, and slowly with due precaution a noble Icthyosaurus was uncovered. He lies 45 feet below the surface; 20 feet in length, the head 2 feet across, and 3 feet 10 inches long. The paddles are unusually distinct, the front pair 2 feet 6 inches, the hind pair 1 foot 8 inches in length. The tail is abruptly curved, and some of the lumbar vertebræ are slightly displaced. The pelvic ring is missing, removed, perhaps, before the nature of the find was guessed, and still to be recovered. The quarry belongs to Mr. M. Lakin, of Leamington, who intends, I understand, to present the specimen to the Natural History Museum at South Kensington. Crowds from all parts of the county throng to see it;

and not a little vigilance is necessary to protect it from dishonest visitors, attempting to purloin teeth or fragments. It has been beautifully photographed by Mr. H. Elkington, of Broadwell, Rugby (a reproduction of the



photograph accompanies this notice), who will, on application, furnish copies to geologists and others desiring them.

W. T.

DR. JOHN HOPKINSON, F.R.S.

THE news that Dr. John Hopkinson, F.R.S., met his death in a terrible mountain accident on Saturday last, has been received with deep regret in the scientific world. His name is familiar to every student of electricity and its applications, and by his death electrical science has lost one of its most active and brilliant workers. It appears from the telegraphic reports that Dr. Hopkinson, who was a practised mountaineer, started from Arolla on Saturday morning, with his son John and two daughters, to ascend the Petite Dent de Veisivi, one of the striking points dominating Evolena, in the Val d'Hérens, running south from the Rhône Valley at Sion. The ascent is not considered a very dangerous one, and the party went without guides. Nothing having been seen of them on Saturday night, search parties were organised, and the melancholy discovery was made that a catastrophe had occurred, the dead bodies of Dr. Hopkinson and his three children being found roped together, but terribly mutilated, at the foot of the highest cliffs. How the accident happened is not known, but probably one of the party slipped whilst climbing a cliff, and all four then fell from rock to rock several hundred feet to the moraine below. Like Francis Balfour and Milnes Marshall, Dr. Hopkinson has lost his life while mountain climbing, and like them also he leaves behind a rich record of work done for the advancement of science.

Dr. Hopkinson was born at Manchester in 1849, and was the eldest son of Alderman Hopkinson, an ex-Mayor of that city. In his sixteenth year he went to Owens College, where he remained for two years and a half, and then went to Trinity College, Cambridge. In 1871 he was Senior Wrangler and First Smith's Prizeman, and was appointed fellow and tutor of his college. While at Cambridge he obtained the D.Sc. degree at London University. Referring some years later to the influences which helped to mould his career, he said:—

"My father cultivated in me a taste for science from a time before I can remember; my mother gave me the first systematic instruction of which I have any recollections. If my father gave me my first taste for science, you may be sure that taste was encouraged at Owens College. Mathematics is the most essential weapon of the physicist, and nowhere can mathematics be learned as at Cambridge. I owe to Sir William Thompson the first impulse to experimental work in electricity and magnetism. He has been to me for many years the kindest of friends, always ready to encourage and to help."

After leaving Cambridge Dr. Hopkinson was for six years with Messrs. Chance and Co., near Birmingham, as their engineer. He removed to London in 1878, and, after commencing practice as a general engineer, took up electrical engineering, in which branch of applied science his most valuable investigations have been accomplished. He was elected a Fellow of the Royal Society in 1878, and received one of the Royal Medals of the Society in 1890, for his researches in magnetism and electricity. In presenting the medal, the President pointed out that Dr. Hopkinson's researches comprised investigations of the effect of temperature upon the magnetic properties of iron, nickel, and various alloys of these metals. Before these investigations were published it was thought that increased temperature tended to diminish the magnetic susceptibility of iron. Dr. Hopkinson's experiments showed, however, that, on the contrary, the magnetic susceptibility increases enormously as the temperature increases, until the temperature reaches about 660° C.; beyond this temperature iron entirely ceases to be magnetic. He also made a series of determinations of the specific inductive capacities and refractive indices of a large number of transparent dielectrics, the results of which are of great importance in the theories of electricity and light. In addition to these researches, he introduced many improvements into lighthouse equipment, notably the "group flashing apparatus."

Dr. Hopkinson's contributions to the theory of dynamo-electric machinery are most important; and to him electricians owe the method, now so extensively used, of solving problems relating to dynamos by the use of the "characteristic curve." On the subject of dynamo-electric machinery Dr. Hopkinson was, indeed, a leading authority. A volume containing a number of his papers on this and allied subjects was published in 1892, and it constitutes a valuable testimony to the scientific and practical importance of his researches. The work contains an account of a very complete and exhaustive set of experiments on dynamo machines under working conditions, and graphical representations of the results. In referring to Dr. Hopkinson's work in these columns, the reviewer remarked: "No device in the whole history of the evolution of the dynamo has been of more general service than his plan of exhibiting the results of experiments in the well named characteristic curve of the machine. This did for the dynamo what the indicator diagram had long been doing for the steam engine, though not, of course, in the same way. With the most admirable simplicity this curve of electromotive forces as ordinates, and currents as abscissæ, gave just the information required regarding the action of the machine." Dr. Hopkinson also showed how the characteristic curve of the dynamo could be used to give the conditions under which an arc lamp could be made to work. He was, in fact, a pioneer in the scientific study of dynamo-electric machinery and its uses. In conjunction with his brother, Mr. E. Hopkinson, he was the first to apply the idea of the magnetic circuit, in a consistent manner, to the discussion of the results of experiments on different types of dynamo, and his contributions to this subject have been most valuable in suggesting new methods and machines. His papers on the behaviour and capabilities of direct current machines, and of alternators, have proved of the greatest service to practical electricians, and are counted among the classics of the subject

Dr. Hopkinson was professor of electrical engineering in King's College, London, and a member of the Councils of the Institutions of Civil and Mechanical Engineers. He was the "James Forrest" lecturer of the former Institution in 1894, and his discourse on the service mathematics has rendered and can render to engineers and engineering was printed at the time in these columns. In himself he represented the rare combination of mathematical and mechanical knowledge, and the results of his life's work stand out as the clearest evidence of the close relationships between pure and applied science. It is a mournful task to have to chronicle the death, in such tragic circumstances, of an investigator who has worked so well for the increase of knowledge and the advancement of electrical engineering.

NOTES.

THE Fourth International Congress of Physiologists held its meetings with great success at Cambridge last week from Tuesday, August 23, to Friday, August 27, inclusive. It was probably the largest assembly of the kind that has yet met. Prof. Michael Foster was President. The following nationalities were represented: Austria, Belgium, Canada, Denmark, Egypt, France, Germany, Great Britain and Ireland, Holland, Hungary, India, Italy, Japan, Roumania, Russia, Sweden, Switzerland, and the United States. The offer of Profs. Mosso (of Turin), and Golgi (of Pavia), for the reception of the Fifth Congress in Italy in 1901 was cordially accepted. The Organising Committee for the Fifth Congress was elected, to consist of the following names: Angelo Mosso (Turin), President. Chr. Bohr (Copenhagen), H. P. Bowditch (Harvard), A. Dastre (Paris), M. Foster (Cambridge), L. Fredericq (Liège), P. Grützner (Tübingen), P. Heger (Brussels), H. Kronecker (Bern), W. Kuhne (Heidelberg), C. S. Sherrington (Liverpool), and W. Wedenskij (St. Petersburg). The place of meeting that has been chosen for 1901 is the Physiological Institute of the University, Turin, and the time the latter half of September. The local arrangements for the present Congress proved very satisfactory. The opinion was generally expressed that the simultaneous session of the sister Congress of Zoologists at Cambridge, far from proving inconvenient, considerably enhanced the pleasure of the meeting.

THE Reale Accademia dei Lincei has recently elected the following men of science as associates and foreign members of the Academy:—National Associates: in physics, Profs. A. Righi, A. Roiti, and A. Pacinotti; in geology and palæontology, Signore G. Scarabelli; in zoology, Prof. C. Emery. Correspondent in mechanics, Prof. C. Somigliana. Foreign Members: in mechanics, Prof. A. G. Greenhill and V. Voigt; in physics, Prof. W. C. Röntgen; in geology and palæontology, Prof. A. Karpinsky and Sir Archibald Geikie; in zoology, Prof. E. Ray Lankester.

IN a special number of their *Atti*, the Reale Accademia dei Lincei, of Rome, announces the recent awards of prizes given by the King of Italy for the period ending in 1895. For the Royal prize for mathematics, eight competitors sent in no less than about ninety written and printed memoirs; and after a critical examination of these, the judges have now divided the prize equally between Prof. Corrade Segre and Prof. Vito Volterra. The papers submitted appear to have been of a very high standard of excellence, and are stated to form a worthy sequel to the works of Betti, Brioschi, and other illustrious Italian mathematicians. The award of the Royal prize for social and economic science has been deferred for a period of two years. A similar decision has been arrived at in the case of the prize for astronomy, but a sum of 3000 lire has been awarded to Prof. Filippo Angelitti in consideration of his valuable work in editing and discussing the unpublished writings of Prof. Carlo Brioschi. The prize for philology has been divided between Prof. Angelo Solerti and Prof. Remigio Sabbadini, and finally a Ministerial prize of 1500 lire for natural science has been awarded to Prof. L. Paolucci for his monograph on the fossil plants of the Ancona district.

PROF. BEHRING'S action in applying for a patent in the United States as sole inventor of diphtheria antitoxin excited surprise, but the announcement that the authorities at Washington have recently decided to grant the patent has (says the *Lancet*) caused a feeling of something like consternation among the American manufacturers of antitoxin. It was in January 1895, that Prof. Behring—his assignees being the Höchst-Farbwerke, the manufacturers of the serum in Germany—first applied for a patent for his diphtheria antitoxin; the application was then refused, and has been refused four times since on the ground that Prof. Behring was not the sole inventor of diphtheria antitoxin, and had consequently no right to claim a monopoly of the manufacture and sale of the same. However, in June of this year the patent officials at Washington overlooked their objections and granted the patent. But although Prof. Behring has succeeded in gaining a patent for his diphtheria antitoxin, it is the intention of the American manufacturers of antitoxin and the several Boards of Health to contest at every step his right to create a monopoly.

PARTICULARS of the life and work of Dr. William Pepper, whose death at Pleasanton, in California, was recently announced, are given in the *Lancet*, and are here abridged. William Pepper was born in August 1843, so that at the time of his death he was not quite fifty-five years of age. His father, Dr. William Pepper, was a prominent physician and Professor of the Theory and Practice of Medicine in the University of Pennsylvania, and in 1881 the son was elected to the same chair. In the same year he was elected Provost of the University, a post which he held until 1894. On his retirement from office he gave practical and munificent effect to his views upon the extension of the medical curriculum by a donation of 50,000 dollars, with a promise of 1000 dollars as an annual subscription for five years, towards an endowment fund to pay for greater teaching facilities for science in the University. In the same year the course was extended to four years. Prof. Pepper is known to the medical profession chiefly by his contributions to, and able editing of, the "System of Practical Medicine by American Authors." This System, which was published in 1885, did for medical knowledge in America what Ziemssen's Cyclopædia had done ten years previously in Germany. It systematised and correlated the varying scientific opinions of persons all chosen to write because of their position and claims to know, and thus presented to the student a comprehensive account of disease in a series of authoritative monographs. As a benefactor to the city of Philadelphia Prof. Pepper's actions were almost innumerable. He gave to the University the William Pepper Laboratory of Clinical Medicine in memory of his father; he inaugurated a system of commercial museums, to be connected with other museums in different parts of the country, wherein people might see specimens of the produce of all parts of the world; he secured immense donations for the Philadelphia Public Art Gallery, and he founded the Free Library. This by no means exhausts the list of Prof. Pepper's public works, and in him Philadelphia is deploring one of the most generous as well as one of the most distinguished of her sons, while the medical world has to mourn the loss of an enlightened man of science, a wise teacher, and a liberal leader.

THE Indian Government has decided to send exhibits from the Forest and Geological departments to the Paris Exhibition, at a cost of about 3000*l*.

WE regret to see the announcement that Mr. E. E. Glanville, of Trinity College, an assistant to Mr. Marconi, has met with his death by falling over a cliff three hundred feet high, at Rathlin Island, off the Antrim coast where he was engaged in experiments in wireless telegraphy.

MUCH interest was excited among the zoologists of the International Congress at Cambridge last week by the announcement of the discovery of the "first known Hyracoid form of the Tertiary formation." The skull upon which this important addition to our knowledge of the Mammalia is based was obtained in Samos, and belongs to the Stuttgardt Museum. It will be described by Prof. Osborn, of New York.

A REUTER telegram from St. Johns states that the steamer *Hope* has arrived there from Greenland, having transferred Lieutenant Peary and party to the steamer *Windward* at Port Foulke. The latter vessel sailed on August 13 for Sherrard-Osborne Fiord, her destination, having taken on board sixty dogs, sixty walruses, and ten natives of North Greenland. It has taken enough provisions for three years.

THE ninth annual general meeting of the Institution of Mining Engineers will be held in Birmingham on September 13, 14 and 15, under the presidency of Mr. A. M. Chambers. Among the papers to be read at the meeting are:—"The Shelve and Minsterley Mining District of Shropshire," by Prof. Lapworth, F.R.S.; "The South Staffordshire Mines Drainage Scheme, with special regard to Electric Power Pumping," by Mr. E. B. Marten and Mr. Edmund Howl; "Treatment of Refractory Silver Ores by Chlorination and Lixiviation," by Mr. J. E. Breakell; "The Use of High-pressure Steam as a Possible Substitute for Gunpowder and other Explosives in Coal Mines," by Major-General H. Schaw.

THE Berlin correspondent of the *Times* states that Herr Theodor Lerner, commander of the German Polar expedition, on his return to Hammerfest, despatched the following telegram to the German Emperor:—"To your Majesty the most humble announcement that the German North Pole expedition, by means of topographical observations made during a circumnavigation of the Island of King Charles, was able to determine its exact position. The ship *Helgoland*, which carried the expedition, is the first ship which has ever yet succeeded in forcing a passage from the south round the eastern coast of the island, which was accomplished in spite of the great quantity of ice and in face of contrary conditions of weather—a feat hitherto considered impossible." The German Emperor, immediately on receipt of this telegram, caused the following reply to be sent to Herr Lerner:—"I send my congratulations to the German North Pole expedition for the splendid success which German determination and circumspection have just achieved under your command.—William, I.R."

A DECIDED change of weather has set in over our Islands during the past week, and the conditions now are quite normal to an ordinary summer. The excessive heat over the south-east of England lasted for about a fortnight, and hot as the days were in many cases they were, in comparison with average conditions, surpassed by the unusually warm nights. At the London reporting station of the Meteorological Office there were eleven nights in August during which the thermometer did not fall below 60°, and the Greenwich observations for the previous twenty years only show altogether eleven such warm nights. Fairly heavy rains have now fallen in all the northern and western districts, and rains of lesser intensity have gradually spread over the whole country. In the neighbourhood of London the rainfall has, as yet, been very small, and the total fall at present since the commencement of the month is only about one-third of the average. In many parts of England the rainfall has been very much below the average during the last eleven months, and there is at present no certainty that the lengthened period of dry weather is at an end. Cyclonic disturbances are just now arriving from the Atlantic with considerable frequency, and these are occasioning rains in many parts of our area. It is, however, not improbable that anti-cyclonic conditions with dry and warmer weather will again shortly set in.

DR. G. AGAMENNONE, in a recent paper in Gerland's *Beiträge zur Geophysik*, describes his attempt to calculate the velocity of the pulsations of the earthquake of Aïdin (Asia Minor), on August 19, 1895. They were registered by the Vicentini microseismograph at Padua, and the horizontal pendulum at Strassburg, the distances of these places from the epicentre being 1570 and 2010 km. respectively. Owing to the uncertainty of the best time-observations near the epicentral district, the estimates of the velocity are somewhat doubtful. The first recorded movements at the above places give velocities of 9·8 and 3·2 km. per sec. for the early vibrations, and 3·1 and 2·55 km. per sec. for those which gave rise to the maximum disturbance.

A FEW notes on the results of inquiries as to the effects and causes of the Indian earthquake of June 12, 1897, are given by Mr. R. D. Oldham in the general report just published on the work carried on by the Geological Survey of India during last year and the first quarter of this year, under the direction of Dr. C. L. Griesbach. An examination of available information leads Mr. Oldham to conclude that there is one, and apparently only one, supposition which will explain all the facts, and that is the existence, or the creation, of a nearly horizontal fracture or thrust plane along which the upper part of the earth's crust was pushed over the lower. This plane would nowhere come to the surface, and the movement of the upper layer against the undisturbed crust beyond the limits of the fracture would give rise to just that compression which would account for the conspicuous displacements of surface levels seen in the eastern part of the Garo Hills District, and less conspicuously to the east and the west. In this conclusion, Mr. Oldham thinks, an easy explanation of the area over which the shock had a maximum of destructive energy may be found without postulating an improbable depth for the focus. There is no necessity or reason to suppose that the thrust plane lies at any great depth from the surface, and it is possible that five miles may represent a maximum rather than a minimum value, but what the focus loses in depth it gains in area of action.

Machinery—the South African journal of engineering, mining, and science—announces that the State geologist, accompanied by Mr. David Draper, has gone to St. Lucia Bay to investigate the connection between the Karoo Beds of the Vryheid District with those of Natal and the High Veld. A geological section of the country will be made from Volkrust eastward, which should be of much value to geologists.

THE *Transactions* of the Edinburgh Geological Society (vol. vii. part 3) contains a large number of interesting papers and notes on geological subjects. Amongst the longer papers we notice two, by Mr. H. M. Cadell, on the geological features of the coast of Western Australia, and on the New Zealand volcanic zone, and one, by Mr. J. G. Goodchild, on desert conditions in Britain. In a footnote Mr. Goodchild states that during the past three years he has taught in his classes that the Torridonian rocks were formed under desert conditions, and that he is not aware that this idea has occurred to any other geologist. The point is important in view of Prof. Penck's recent discussion of the same subject.

IN the latest volumes of its *Memoirs* the Russian Geographical Society has published the diaries of three expeditions made in East Siberia many years ago, but the detailed accounts of which had hitherto remained unknown. Two volumes are given to two diaries of the mining engineer, I. A. Lopatin, who visited the northern parts of the Vitim plateau in the year 1865, and the next year travelled along the Lower Yenisei to Turukhansk. The former contains a wealth of minute descriptions of the granites, gneisses, and crystalline slates of the Vitim plateau, all described from Lopatin's samples by specialists, as well as of the mantles of basalt which cover large portions of the plateau along its north-western edge. The second volume is even more interesting, as on his journey down the Yenisei Lopatin met not only Laurentian and Huronian formations, but also widely-spread Silurian rocks, Quaternary deposits, and Post-Pliocene deposits of the Arctic Sea, very rich in sub-arctic shells (all fossils were described years ago by Fr. Schmidt in his "Mammuthexpedition"). The third volume of this series contains the diary of the remarkable explorer, A. L. Czekanowski, of whose expedition to the Lower Tunguska, the Olenek and the Lena, in 1873-75, Fr. Schmidt rightly says that it was richer in geological results than any of the expeditions that have explored Siberia. The results of this journey were well known through Czekanowski's preliminary reports, as well as through the descriptions of his palæontological and botanic collections by Oswald Heer, Lagusen, Moisisowicz, Fr. Schmidt, and Trautvetter. But a full description of the expedition was never published, and it is only now that Czekanowski's diary, which contains a mass of most valuable information, sees the light. Fr. Schmidt contributes to this volume a sketch of the tragic life of the author, who was exiled to Siberia after the Polish insurrection of 1863; then, after several years spent in hard labour, was allowed to make his memorable journeys, and was permitted to come to St. Petersburg in 1876. He was not allowed, however, to remain in the Russian capital, and being compelled to return to the land of exile, he poisoned himself at the age of forty-four. An excellent portrait of this remarkably energetic worker is given in the volume which contains his posthumous work.

A SUMMARY of recent advances in the photography of air waves, formed by flying projectiles, is given in *Engineering* for August 12, accompanied by a number of fine illustrations. Perhaps the most interesting recent development of the subject is to be found in the attempts of Mach to study the phenomena by means of interference bands. From these it is concluded that though the air is pushed forward and outward by the projectile, the compression does not, in the case of a steel shell, correspond to more than a pressure of a fifth of an atmosphere; further, there is, indeed, something like a vacuum immediately behind the projectile, but this vacuum only extends through a short distance.

A PRELIMINARY note on the influence of electricity on the sedimentation of turbulent liquids, is contributed to the *Bulletin de l'Académie royale de Belgique* by M. W. Spring. After observing that water will sometimes hold finely divided matter of greater density than itself in suspension for an indefinite time, but that the presence of small quantities of salts in solution, or heating the liquid, will suffice to bring about precipitation, M. Spring states that a medium formed of pure water containing finely divided silica, or other non-electrolytic matter, begins to clarify gradually as soon as two platinum electrodes are plunged into it and a current passed through them. From this experiment the author proposes to develop a theory according to which the turbulent state is caused by a modification of the electric state of the finely divided particles, caused by the change in the energy of attraction of the matter forming them, consequent on disintegration. The presence of a dissolved salt or acid renders the liquid a conductor, and the discharge of electricity causes the particles to collect in flocculent masses; an explanation in accordance with Bodländer's view, that only electrolytes are capable of producing clarification. Again, convection currents produced by warming the liquid give rise to electric currents which also have the same effect. M. Spring proposes to go further and explain the fall of rain accompanying thunderstorms on the same theory. We wonder if he has thought of trying the effect of Röntgen rays on turbulent liquids; if not, his present theory suggests that the results of doing so might be interesting.

IN Tasmania, writes Mr. Stuart Dove in *Nature Notes*, the "blue-tongued lizard," the *Tiliqua nigrolutea* of naturalists, takes the place of that noted cobra-destroyer, the Indian mongoose. The blue-tongued lizard is a stout formidable-looking animal much given to lying about the bush roads and tracks, asleep in the sun, which heaviness of disposition has earned for it the name of "sleeping lizard." But should a snake come in sight, the sleepiness disappears instantly and every nerve of the lizard seems on the alert, every sinew toughened to meet the enemy. The snake usually tries to get away, but the lizard prevents it, and a fight commences, the two reptiles darting and dodging and savagely snapping at one another. The snake soon shows signs of being exhausted, and the lizard then twists it over with a quick dexterous turn and gives it a *coup de grace*. The lizard afterwards takes the head of the snake between its strong jaws and slowly devours the dead reptile, after which he retires to the shelter of a hollow log to sleep off the repast.

A SHORT but interesting paper by Prof. W. C. McIntosh, on the memory of fishes, is referred to in the *Journal of the Royal Microscopical Society* (August). Prof. McIntosh refers to "the behaviour of a large grey skate in its endeavour to escape over a trawl-beam more than fifty feet long, which had been arrested in its rise—just above the surface of the sea—by a temporary block in the machinery. The dexterity with which it skimmed to and fro along the beam to find where it dipped sufficiently during the movements of the ship to enable it to glide over was a study. . . . If those who have given a green cod of six or eight inches a particular kind of 'scale-back' (a kind of worm), and noticed, firstly, how eagerly it seized it, then tested it in its pharyngeal region, and soon ejected it, never again taking that species into its mouth, they would be slow to deny that fishes, and even very young fishes, have a memory." A number of very suggestive cases are given, and the author concludes: "With regard to the absence of cortex of the brain in fishes, this is probably only a question of degree—easily understood by referring to the descriptions and figures of the brain in the salmon and the wolf-fish. Besides, who has proved that the function of memory depends on the brain-cortex of the human subject? I have seen many a curious case in the pathological room, the history of which would not have led us to this conclusion."

MR. W. L. SCLATER, Director of the South African Museum, reports that the state of the collections is satisfactory, and increasing use is being made of the museum by workers in different branches of natural science. The collections are now in the new museum building, which was formally opened on April 6. During the year covered by the report, 6380 specimens were added to the collections, 289 of them being species new to the museum. A complete list of the acquisitions to each department is given in the report. The number of insects received by the department of entomology was 2309, representing 766 species. As usual, the order Coleoptera predominates in the accessions, and Mr. L. Péringuey is able from the data now available to estimate that the number of South African Coleoptera will prove to be no less than 12,000. Mr. Péringuey refers to the interesting discovery of the existence of a representative of the curious family *Embiidæ* of the order Neuroptera, not before recorded in South Africa; and the curious parallelism of some coleopterous forms inhabiting the Cape and the Canary Islands, as exemplified by captures made by M. A. Raffray in the immediate vicinity of Cape Town. M. Raffray lately discovered a species of *Metophthalmus* (family Lathridiidæ), three species of which are represented in the Canary Islands; he also discovered an eyeless species of Weevil (nov. gen.), and another the eyes of which have only six facets. These insects, belonging to the sub-family *Cossoninæ*, are very closely allied to similar ones occurring in the Canary Islands, and which are also found in the extreme south of Europe. Wollaston, as far back as 1861, described a Colydid (gen. *Cossyphodes*) from the Cape, belonging to a genus known at the time as occurring only at Madeira. Another species was later on discovered in Abyssinia, It is a singular coincidence that both *Cossyphodes* and *Metophthalmus* should be discovered in such opposite directions. Mr. Péringuey thinks the true explanation is that the minute insects of Africa have not yet been properly collected, and that the genera mentioned will be found to have a larger area of distribution than at first imagined.

SINCE the Liverpool Biological Committee transferred its headquarters to Port Erin, the station on Puffin Island has been worked by a committee of residents in North Wales, under the direction of Prof. White, of Bangor. The report for 1896 and 1897, which has recently appeared, shows that the Committee is extending its sphere of action to the study of the fauna and flora of the North Welsh *littoral*, as well as to the archæology of Puffin Island itself. It contains papers by Prof. Phillips on the brown seaweeds of Anglesey and Carnarvonshire, on an interesting form of *Ectocarpus confervoides*, and on a new variety of the alga *Epicladia flustræ*; by Mr. Daniel A. Jones, on the moss flora of the Harlech coast; by Prof. White, on some fishes observed in the Menai Straits, and on Welsh fishery exhibits at the Imperial Institute; by Mr. Harold Hughes, on excavations on Puffin Island; and a description, by Sir William Turner, of a skeleton recently discovered in the course of these excavations.

MR. BERNARD QUARITCH has just issued a catalogue of many rare and valuable works on zoology offered for sale by him.

IN addition to the usual bi-monthly summary of current researches relating to zoology, botany, and microscopy, the *Journal of the Royal Microscopical Society* for August contains several short papers of special interest to microscopists. The President, Mr. E. M. Nelson, contributes an article on the errors to be corrected in photographic lenses, and Mr. P. E. Bertrand Jourdain describes a new apochromatic objective constructed without the use of fluorite; a method of adjusting the sizes of the coloured images yielded by the Cooke lens; and the construction of the planar lens, and its use in low-power photomicrography.

IN his "Electricity and Magnetism," published at St. Louis by the John L. Rowland Book and Stationery Co., Prof. Francis E. Nipher gives a mathematical exposition of the fundamental principles of these subjects, for students who have commenced the calculus. A second edition of the volume, revised and with additions, has lately appeared, and the electrical engineer who is first of all a student, can acquire from it a sound knowledge of the machinery of mathematics, while the results may be safely applied to the work of designing electrical machinery.

WE have received a copy of a statement, being a report to the Lawes Agricultural Trust Committee, prepared by Sir J. Henry Gilbert, F.R.S., on the origin, plan, and results of the field and other experiments conducted on the farm and in the laboratory of Sir John B. Lawes, F.R.S. Other evidence of the activity of the investigators at Rothamsted is afforded by three papers, which have come to us with Sir Henry Gilbert's report, dealing with the growth of sugar beet and the manufacture of sugar in the United Kingdom; the valuation of the manures obtained in the consumption of foods for the production of milk; and, the Royal Commission on agricultural depression, and the valuation of unexhausted manures.

A VOLUME of "Agricultural Statistics of British India, for the years 1892–93 to 1896–97," compiled by the Statistical Bureau of the Government of India, has just been published. From the immense amount of material therein contained, we note one or two points of interest concerning the progress of cultivation of tea, coffee, and cinchona from 1885 to 1897 in British India and the native States. In 1885 the number of acres upon which tea was cultivated was 283,925, and the total production of tea was 71,525,977 lbs. In 1896 the number of acres under tea was 433,280, and the total production was 156,426,054 lbs. Coffee does not show the progressive increase of cultivation exemplified by tea. In the year 1885 the number of acres under coffee was 237,457, and the yield 34,959,295 lbs., but in 1896 the larger area of 289,084 acres only produced 26,086,902 lbs. As to cinchona, the number of acres under cultivation, and the number of trees in permanent plantations, have decreased since 1885, the quantity of bark collected in 1896-97, viz. 1,491,566 lbs., being the least obtained since 1889.

THE third part of vol. liv. of the *Quarterly Journal of the Geological Society* has just been published. From the large number of papers which are here printed, two or three are especially worthy of mention. Mr. T. Codrington discusses the submerged Rock-valleys in South Wales, Devon, and Cornwall. Mr. F. W. Harmer gives the results of a valuable series of borings which he has made with the object of arriving at a satisfactory conclusion as to the relation of the Lenham Beds and the Coralline Crag. Prof. Bonney deals with the Garnet-Actinolite schists on the southern side of the St. Gothard Pass. Mr. F. A. Bather elucidates the structural characters and affinities of *Petalocrinus*, and shows that its base is dicyclic and not monocyclic, as originally thought. Moreover, axial canals, covering-plates, the articular facet, and various minor structures are described in this genus for the first time. Miss G. L. Elles' exhaustive account of the Graptolite-fauna of the Skiddaw Slates confirms the chief conclusions of Prof. Nicholson and

Mr. Marr, though in several matters of detail different results are reached. Other important papers complete what is a particularly interesting issue of the *Journal*.

THE additions to the Zoological Society's Gardens during the past week include two Maholi Galagos (*Galago maholi*), a Bosch Bok (*Tragelaphus sylvaticus*, ♂), two Cape Zorillas (*Ictonyx zorilla*), a Hoary Snake (*Pseudaspis cana*), two Rough-keeled Snakes (*Dasypeltis scabra*), twelve Crossed Snakes (*Psammophis crucifer*), two Rufescent Snakes (*Leptodera hotambœia*), two Smooth-bellied Snakes (*Homalosoma lutrix*), two Puff Adders (*Bitis arietans*) from Port Elizabeth, Cape Colony, presented by Mr. J. E. Matcham; a Fat-tailed Sheep (*Ovis aries*, ♂, var.) from Cape Colony, presented by the Hon. Sir James Sivewright, K.C.M G.; an African Civet (*Viverra civetta*) from West Africa, presented by Lieut. Carroll and Major Arthur Festing; a —— Gannet (*Sula*, sp. inc.), captured at sea, presented by Captain Ernest W. Burnett; two Alligators (*Alligator mississippiensis*) from North America, presented by Mr. O. Moser; a Common Viper (*Vipera berus*), two Common Snakes (*Tropidonotus natrix*). British, presented Mr. W. F. Blandford; twelve African Walking Fish (*Periophthalmus koelreuteri*) from West Africa, presented by Dr. H. O. Forbes; a Reticulated Python (*Python reticulatus*) from Malacca, two Indian Pythons (*Python molurus*) from India, deposited; an Indian Chevrotain (*Tragulus meminna*, ♂) from India, purchased; a Burrhel Wild Sheep (*Ovis burrhel*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN SEPTEMBER:—

September 5. 16h. 44m. to 17h. 41m. Occultation of 66 Arietis (mag. 6·1) by the moon.
8. 10h. 52m. to 11h. 42m. Occultation of DM + 24° 1033 (mag. 6) by the moon.
9. 1h. 31m. to 2h. 19m. Occultation of Mars by the moon.
10. 14h. 5m. to 14h. 30m. Occultation of 79 Geminorum (mag. 6·5) by the moon.
12. 11h. 27m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc 0·521. Diameter 23″ 2.
15. Mars. Illuminated portion of disc 0 880. Diameter 6″·8.
15. 8h. 16m. Minimum of Algol (β Persei).
17. Saturn. Outer minor axis of outer ring, 16″·43.
21. 3h. Mercury at greatest western elongation (17° 51′).
21. 5h. Venus at greatest eastern elongation (46° 27′).
26. Vesta 20′ S. of Saturn.
28. 13h. 39m. to 14h. 44m. Occultation of 16 Piscium (mag. 5·6) by the moon.

The planet Mercury will be favourably presented as a morning star between about September 18 and 27. The time of his rising compared with that of the sun will be as under:—

Date.	Mercury rises. h. m.	Sun rises. h. m.	Interval. h. m.
September 18	4 3	5 40	1 37
19	4 3	5 42	1 39
20	4 2	5 43	1 41
21	4 3	5 45	1 42
22	4 4	5 46	1 42
23	4 6	5 48	1 42
24	4 9	5 49	1 40
25	4 13	5 51	1 38
26	4 16	5 53	1 37
27	4 20	5 55	1 35

THE GREAT TELESCOPE FOR THE PARIS EXHIBITION.—We gather from an article in *La Nature*, August 27, that M. Gautier, the well-known optician, is making good progress with the construction of the giant telescope intended for the Great Exhibition at Paris in 1900. The aperture will be 1·25 metres (49·2 inches), and the focal length 60 metres (196 feet 10 inches), while the estimated cost is 1,400,000 francs. An equatorial mounting and dome for such a gigantic instrument may well be considered impracticable, and accordingly the telescope itself will be rigidly fixed in a horizontal position on supports of masonry, and will receive the light of the heavenly bodies after reflection from a movable plane mirror 2 metres in diameter. The plane mirror is 13 inches thick, and weighs 3600 kilogrammes; and it is curious that of twelve discs cast for the purpose, the first one turned out to be the best. This has been in process of grinding for seven months, and is not yet finished.

There will be two objectives, one photographic and one visual, which will be easily interchangeable at will. It is expected that a magnifying power of 6000 will be usefully employed, and that occasionally a power of 10,000 may be used. As the highest power available in the largest existing telescope does not exceed 4000, the new instrument, if it be the success that every one will wish, should have a wide field of usefulness.

A NEW VARIABLE STAR.—In *Ast. Nach.*, No. 3512, Prof. Ceraski, Director of the Moscow Observatory, announces the discovery, by Madame Ceraski, of a new variable star. The variability was detected by a comparison of photographs, and has been confirmed by visual observations. Its estimated position is in R.A. 21h. 6·9m., Decl. + 82° 28′ (1855); that is, not far from 76 Draconis. The range of variation is not stated, but it is mentioned that on July 25 it was of the tenth magnitude.

MINOR METEORIC RADIANTS.—In view of the large amount of attention which will probably be directed to meteoric displays during the next few years, Mr. Denning summarises in *Ast. Nach.*, No. 3513, the positions of the radiant points of the minor showers visible during the principal meteoric epochs. The catalogue comprises fifty radiants observable at each of the six periods corresponding to the displays of Quadrantids, Lyrids, Perseids, Orionids, Leonids and Geminids. As the Andromedes fall near and between the Leonids and Geminids, a separate list is unnecessary for this epoch. It is seen from the table that some of the positions for radiants are almost the same at different epochs, and Mr. Denning again draws attention to his conclusion that "certain radiants are actively maintained (though possibly with varying or intermittent intensity) over considerable intervals of time, during which their positions are quite stationary among the stars." The list will be invaluable to those who take up observations of shooting-stars.

THE INTERNATIONAL CONGRESS OF ZOOLOGISTS.

THE fourth International Congress of Zoologists, under the patronage of H.R.H. the Prince of Wales and the presidency of the Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., which met last week at Cambridge, may be chronicled as a success, as well from the social as the scientific point of view. The discussions were animated, the sectional papers of general interest, and the attendance was large and representative. The severity of the zoological discussions was relieved by frequent social festivities, of which the reception at the Guildhall by the Mayor of Cambridge on Monday, and the open air party at the Botanic Gardens on Thursday afternoon, were especially noteworthy.

The Congress is a triennial one, and has already been held at Paris, Moscow and Leyden. This is the first occasion that the Congress has met on English soil, and it is gratifying to find that more members were in attendance last week than were present at any of the three preceding Congresses. The programme for the week was drawn up in such a way that the topics of general interest were discussed in the mornings before the whole body of the members, while those of more limited interest were divided into four sections—(A) General Zoology, (B) Vertebrata, (C) Invertebrata, excepting Arthropoda, (D) Arthropoda, and were read in the afternoons.

Tuesday, August 23.—Sir John Lubbock, in opening the Congress, expressed his regret at the absence through continued ill-health of Sir William Flower, who, at the Leyden meeting in 1895 was made President-Elect for the present Congress.

He then delivered the presidential address, which was printed *in extenso* in our last week's issue.

Profs. Milne-Edwards, Jentink, Collett, Haeckel, von Graff, Hertwig, Marsh, Mitsukuri, Salensky and Vaillant were elected Vice-Presidents; and Dr. Hoek, Dr. Gadow, Dr. Plate and M. Janet were elected Secretaries of the Sections. The meeting then proceeded to receive the reports of committees appointed at the third Congress to consider various matters of zoological importance. The committee on zoological nomenclature, having been unable to come to a unanimous decision, applied for power to add to their number, which was granted. The question of zoological nomenclature was, therefore, not discussed at the Congress, but was referred back for consideration by the augmented committee. Dr. P. Hoek announced, on behalf of another committee, that favourable arrangements were about to be made with the international postal authorities for the transmission of animals and plants not intended as merchandise.

In the afternoon, in Section A, Mr. Stanley Gardiner read a paper on the "Building of Atolls," suggesting that the depths at which corals and nullipores live is determined by the depth to which light can penetrate sea-water, the food of corals being derived entirely from the commensal algæ. The form of the atoll-reef was shown to be due to the continuous addition of marginal buttresses and the dissolution of the central parts. In this, and in other respects, the author supports the theory of atoll-formation propounded by Sir John Murray. Prof. Mitsukuri, discoursing on "Zoological matters in Japan," pointed out that the transition from comparative barbarism to the present degree of scientific culture has not been as sudden as is generally supposed. He quoted some scientific works published in Japan in the ninth century, and called attention to the foundation of the Botanical Gardens of the University of Tokyo in 1681. He gave an account of the zoological laboratories at Tokyo, and of the marine station which has recently been erected near that town. Prof. Salensky read a paper on "Heteroblasty," by which name he designates the origin from different embryonic sources of organs, similar in position and function, in nearly related animals. He adduced as examples the development of the alimentary tract from the ectoderm in insects; the development of the peribranchial cavities in buds and embryos of Ascidians, and the development of the heart in Ascidians and Vertebrates.

In Section B, Prof. Milne-Edwards read a paper on the "Extinct Animals of Madagascar," in which he referred to the valuable collections made by M. Grandidier and Dr. Forsyth-Major. He compared the *Æpyornis* with the *Dinornis* of New Zealand, and drew a parallel between the extinct fauna of Madagascar and that of the Australasian area.

Prof. O. C. Marsh made a communication on the "Value of Type Specimens and the Importance of their Preservation," dealing more especially with the extinct Vertebrata. He pointed out that the value of type specimens depends on the maturity of the animal and the state of preservation and completeness of the parts. Type specimens must show characteristic features. The association of fragments to supplement an incomplete type is a practice fraught with great danger of confusion to subsequent investigators. Prof. Marsh advocated depositing types in large endowed museums as affording better chances of safe preservation than local museums; and he regarded it as a wise regulation that type specimens should not be permitted to leave the museum in which they are deposited.

Dr. Van Bemmelen showed that in *Ornithorhynchus* the temporal arch has two roots instead of one, a fact which suggests forcibly the articulation of the mandible with a persistent quadrate, as in reptiles. Prof. Seeley pointed out that the discovery had previously been made by himself.

Mr. Graham Kerr described the habits and development of *Lepidosiren*, and exhibited a splendid collection of specimens which he collected during his recent stay in Paraguay.

In Section C, Prof. Plate gave an account of the "Comparative Anatomy of the Chitons," showing that in these molluscs, generally believed to be the most primitive of existing Gastropods, there is a far greater diversity of internal organisation than might be suspected from their uniform appearance. Prof. Plate also described a newly discovered Protozoan which lives as a parasite in the mantle cavity of *Chiton*. Mr. E. S. Goodrich demonstrated the structure of the complex nephridial organs which occur in the Polychæte worm *Glycera*. Mr. C. F. Rousselet described a new method of preserving Rotifers in the extended condition, by narcotising them by the slow addition of a weak solution of cocain, and then killing them by a weak solution of osmic acid. The specimens are best mounted in formol. Some excellent specimens prepared in this way were exhibited.

In a paper read in Section D, on "Some points in the classification of Insects," Dr. David Sharp pointed out that in some insects the wings are developed outside the body, while in the others they do not appear at all, or are developed inside the body and are subsequently everted; and he claimed that in a classificatory scheme the perfection or imperfection of the metamorphosis should be subordinated to this feature. He proposed, therefore, to divide the insects into four groups, the *Apterygota*, quite wingless and in all probability descended from wingless ancestors, the *Anapterygota*, which, though wingless and parasitic, exhibit an acquired ametabolism as regards the wings, the *Exopterygota*, in which the wings are developed outside the body, and the *Endopterygota*, comprising the vast majority of existing hexapod insects, in which the wings develop inside the body. With regard to the geological antiquity of the groups, there is evidence to show that the exopterygotous insects are the most primitive, they only extending as far back as the Palæozoic.

Mr. M. C. Piepers summarised the results of his observations on the colours of insects in a paper entitled "Evolution of Colour in Lepidoptera," in which he concludes that there has taken place, and is still in progress, a process of colour-change affecting not only the metamorphosis of a given species, but also the evolution of the species and genera of a family. He would explain colour-polymorphism as a phenomenon of arrestation of this continuous evolution at varying stages, and sexual colour-differences as due to unequal advances by the two sexes in the same direction. The existing Pieridæ are, according to this view, evolved from a reddish ancestor. With advancing evolution the colour has become paler; first orange, then yellow, and in the most highly evolved species a pure white. Albino specimens of a species normally yellow are to be regarded as sports which have advanced further in this evolutionary scale than the majority. The progression of colour-change is not, however, the same in all families of Lepidoptera. In some, for instance, the primitive colour is red, and the successive stages are gradually darker, culminating in black.

A communication was also read from M. Bordage, giving the results of experiments made by him to determine the relation of the colour of the chrysalids of certain species of Lepidoptera to the colour of their environment. The chrysalids of *Papilio demolens* and *P. disparalis* appeared to be completely insensitive to the colour of their surroundings; but the experimenter has witnessed distinct, though feeble, efforts to respond on the part of *Atella phalanta*, *Euploea goudotii*, and *Danais chrysippus*. The intensity of the light and the brightness or dulness of the surroundings appear to be more important factors than the actual colour of the latter. The age of the chrysalis also materially affects the result.

On *Wednesday* morning a general meeting of the Congress was held to discuss the position of the Sponges in the animal kingdom. Prof. Yves Delage, in opening the discussion, proposed to confine his attention to the determination of the value to be attached to the differences between the sponges and the Cœlenterates, with the object of deciding whether the sponges ought to constitute a subdivision of the Cœlenterates or to stand apart from them as a separate phylum. He dismissed shortly such features as the presence of collar-cells and the absence of nematocysts, but laid special stress upon the structure of the sponge larva and the relations of the parts of the blastula to the permanent tissues of the adult. He described how the sponge blastula consisted in its upper part of small clear cells with flagella, and in its lower part of larger, granular, brownish cells destitute of flagella; and how the former layer, having the histological characters of ectoderm cells, have the development of an endoderm, being invaginated into the interior of the other cells. After mentioning recent experiments on the effect of salts of lithium and of varying temperatures on the mode of invagination of the blastula in Echinoderms, he said he was inclined to regard the so-called ectoderm as really an ectoderm, and the cells which resemble endoderm cells as really endodermal. The sponges and Cœlenterates run parallel in their development from the ovum to the blastula stage, but then take diverging courses. He would advocate, therefore, the recognition of the sponges as a phylum distinct from the Cœlenterates.

Prof. Delage was followed by Mr. E. A. Minchin, who commenced with an historical review of the subject. After pointing out that the animal nature of sponges was not definitely established until the middle of the present century, he proceeded to explain that the early theory that sponges were Protozoa was abandoned as soon as histological methods improved, and it became known that sponges were composed of tissues, made up of differentiated cells. Three views are, he said, at the present day advocated by different authorities: (1) that sponges are Cœlenterates; (2) that they are Metazoa, but not Cœlenterates; and (3) that sponges are not Metazoa, but constitute a phylum independent of both the Protozoa and Metazoa. The question might be attacked by two methods, the comparative anatomy of adult forms and the tracing of the germ-layers of the larva into the permanent tissues of the adult. He then gave a minute account of the development of *Clathrina blanca*, based on his own researches, and indicated with the assistance of wall-diagrams the fate of the flagellated and the granular cells. The conclusion he arrived at was that the sponges cannot be considered as Cœlenterates; for, if the larvæ of sponges and Cœlenterates are assumed to correspond, neither the architecture nor the composition of the adults is in any way comparable; while if the comparison is based on adult structures, then the larval development of sponges is altogether anomalous and dissimilar to any other known development, since the ectoderm acquires an internal position and becomes surrounded by the endoderm. The evolution of the sponges from the Protozoa must therefore have been quite independent of that of the Cœlenterates; and it is probably in the direction of the Choanoflagellate Protozoa that we must look for the ancestral stock of the sponges, since collar-cells are not known to exist except in these groups. In the discussion which followed, Prof. Hæckel expressed himself as still in favour of the cœlenterate theory; Dr. Vosmaer regretted that he had been asked to speak, because it forced him into a confession of ignorance regarding the point at issue; and Mr. Saville-Kent urged that the vexed problem of sponge affinities should be fairly approached from the protozoic as well as from the cœlenterate basis. The very fact of the possession in common by the sponges and by the flagelliferous Protozoa of these very peculiarly modified cells, found nowhere else throughout the animal kingdom, suggested forcibly a close phylogenetic relationship between these two groups. Prof. Schulze doubted whether the recent embryological discoveries were sufficient to justify the removal of the sponges from the Cœlenterates.

In the afternoon in Section A, Prof. Haeckel, in a paper entitled "Phylogenetic Classification," developed the principles which he had first enunciated in his "General Morphology," and more recently in his "Systematic Phylogeny" (1896). He regarded the *Vertebrates*, *Tunicates*, *Echinoderms*, *Molluscs*, *Cnidaria*, and *Sponges* as true phyla (*i.e.* monophyletic groups, arising from a common stem), but grouped the Annelida with the Arthropoda in the phylum *Articulata*, and the Cestoda and Trematoda with the Cœlenterata.

Prof. von Graff then demonstrated with the aid of a large map the geographical distribution of the land Planarians; and Mr. G. C. Bourne gave an account of the "Structure and Formation of the Calcareous Skeleton in the Anthozoa," showing that the corallum of the madrepores is not formed by the calcification of ectoderm cells *in situ*, but is a secretory product of the cells.

In Section B, Profs. Heymans and Van der Stricht gave an account of the ultimate ramifications of the nerves of *Amphioxus*, which they had succeeded in tracing out by adopting the elaborate methods of staining which histologists have of late years found to yield such excellent results in the investigation of nervous tissues of mammals.

Prof. Ewart exhibited by means of the lantern some photographs of the zebra-horse hybrids which he has bred in his attempt to prove or disprove the theory of telegony. He described the striping of the various species of zebra and of his hybrids, and showed that the latter do not closely resemble their sire, a Somali zebra, in the pattern of their coat. The dams of three of these hybrids have since borne foals to horses of their own breed, and one of these foals, now dead, is plainly striped, the second faintly so, while the third shows no striping at all. Prof. Ewart is not yet prepared to accept telegony as a scientifically established fact, since the colour-markings of these foals might be explained on the hypothesis of "reversion."

A paper on the "Tsetze Disease in Mammals," by Prof. Kanthack and Mr. Durham, was read and illustrated by slides, showing the living hæmatozoan and its relation to the blood corpuscles. The rapid spread of the disease is due to the Tsetze-fly carrying the organisms from infected ungulates to healthy ones as they pass through those deadly regions of Africa known as "fly-belts." The organisms cannot live in the blood more than three or four days, but reproduction is rapid, taking place in the lymphatic glands and the red marrow; and thus a plentiful supply is kept up until the host succumbs. Death appears to be due either to the fatal action of some toxin excreted by the organism, or to direct interference with the corpuscle-forming organs of the body. The mere presence of the organisms in the blood is not sufficient to cause death. The authors have not been able to discover any means of securing immunity for domesticated animals; but, since the wild mammals of South Africa though frequently found to be infected do not die of the disease, they are sanguine of ultimate success in this direction.

Mr. W. Saville-Kent, who a few years ago showed that the lizard *Chlamydosaurus* had a habit of frequently running about upon its hind legs, explained that the habit was not confined to this genus. He had found it to be common to certain species of *Iguana*, *Tupinambis* and *Basiliscus*.

In Section C, Prof. F. Vejdowsky brought forward some observations on the ova of *Rhynchelmis*, substantiating the view expressed by him elsewhere, that the dynamic body known as the "centrosome" originates by the differentiation of the middle part of the "attraction sphere" of the preceding division. Prof. Hickson gave a demonstration on the medusæ of *Millepora*, and Prof. Pelseneer communicated two short papers.

In Section D, M. Ch. Janet propounded a theory that in the head of insects parts belonging to six primitive segments can be recognised. The anterior three are characterised by the protocerebrum, deutocerebrum and tritocerebrum respectively, and the other three by the appendages—mandible, maxilla and labium. The antennæ are regarded by the author as belonging to the second segment. These results are based mainly upon a minute study of the musculature of the head of the ant.

M. A. Dollfus discoursed on the geographical distribution of the Isopods of Northern Africa; M. E. Olivier gave a general account of the Lampyridæ of the Antilles; and Prof. E. Bouvier communicated the results of his studies on the external characters of *Peripatus*.

On *Thursday* morning, at the Guildhall, an interesting debate on the "Origin of Mammals" was opened by Prof. Seeley, of London, and Prof. Osborn, of New York. Prof. Seeley said that as the Iguanodont reptiles had been regarded as the ancestors of birds, so the Theriodont reptiles had been considered the ancestors of mammals. The discovery of the complete skeleton of *Pareiasaurus* showed that *Theriodesmus* was not a mammal, as had been supposed; and in the same way, the discovery of the Gomphodont reptiles had necessitated the removal of *Tritylodon* from the mammals to the reptiles. *Pareiasaurus*, *Dicynodon* and *Cynognathus* showed different affinities in different parts of the skeleton, and from the skull of the two former no indication could be inferred of the mammalian resemblances seen in other parts of their skeletons. The Anomodontia appeared to show affinities with the lower living reptiles as well as with more than one type of mammal. The form of the brain if it were available would be evidence of affinity of some value, but the brain-cavity of Anomodonts is imperfectly known, and there is no evidence that the brain filled it. Prof. Seeley invited comparison of the quadrate region of the skull in the Dicynodonts and *Ornithorhynchus*, but remarked on the absence of prepubic bones in the Anomodonts. He showed that the Theriodont division of the Anomodonts approached the mammalia in the characters of the teeth and the very small size of the quadrate bone; while, on the other hand, they suggested affinities with the Labyrinthodont reptiles in the presence of such cranial bones as the supratemporal, and of intercentra in the vertebræ. Although the parts of the pectoral and pelvic girdles bore a close comparison with those of the Monotremes, and although in many Theriodonts the skull was typically mammalian in form, the mandibular ramus never consisted of a single piece as in mammals. The Anomodonts were not the parents of mammals, but a collateral and closely related group; and the common parent of both might be sought in rocks older than the Permian, perhaps in Silurian or Devonian strata.

Prof. Osborn said that in order to clear the ground for a successful attack upon the difficult problem of the origin of mammals it was necessary first to reject the hypothesis, brilliantly formulated by Huxley in 1880, of a genetic succession between Monotreme, Marsupial and Placental types, since this could not be supported by either palæontology or comparative anatomy. He explained the law of adaptive or functional radiation whereby mammals have repeatedly diverged from small unspecialised focal types into aquatic, arboreal, volant, herbivorous and carnivorous orders, and pointed out that the balance of evidence among the mammals, as among the reptiles, is in favour of all aquatic types being secondarily evolved out of land types. All carnivorous and herbivorous types were over-specialised, or in a *cul de sac* of development, so that it was probable that the Promammal was a small terrestrial animal, either insectivorous or omnivorous in its habits. There was abundant evidence that many of the small mammals of the Middle and Upper Jurassic were not Marsupials, but insectivorous Placentals, fulfilling all the conditions required for the ancestry of the living Insectivora and the Creodonta, and, through the latter, of all the higher existing types of mammals, including man. Leaving the mammals, he remarked that the Theriodonts and Gomphodonts were surprisingly Promammalian in type, and that we were strongly tempted to connect the latter division, which is herbivorous, directly with the herbivorous Monotremes and Multituberculates. The large size and high specialisation of these types was, however, opposed to this view. In concluding he said that South Africa was at the present time a centre of the highest interest, and that for further developments of the problem of the origin of mammals we must probably look to the rich fauna of the Karoo beds.

In the discussion which followed, Prof. Marsh said that the mammals themselves comprised so many different groups that it was a fair question whether all these had a common origin. The supposed resemblance between the teeth of the Anomodont reptiles and those of mammals was not confined to one group. The extinct crocodile *Notosuchus* recently found in Patagonia has the three kinds of teeth well developed; and in the genus *Triceratops*, of the Dinosaurs, all the teeth have two roots—a supposed mammalian character; but no one had yet attempted to derive the mammals from the Crocodiles or the Dinosaurs. Prof. Marsh declined to admit that any reptiles possess a true double condyle, since in the known forms the two parts are in contact below, forming essentially a single cordate condyle, as in some of the Chelonia. Again, all reptiles have a quadrate bone, which may be small and partly enclosed in the squamosal, but never lost. No known mammal has a true quadrate, and the attempts to identify that bone in the mammalian skull have not been successful. Most important of all, the lower jaw of all reptiles is composed of several pieces, even the Anomodonts showing the sutures distinctly. There was, said Prof. Marsh, a great gulf between mammals and reptiles which it was at present difficult to bridge over. Prof. Haeckel then spoke in high terms of the excellent palæontological work which was being carried on in America, and the value of the recent discovery of annectent forms. He was inclined to adhere to the view of the origin of all Placental mammals from Marsupials. Mr. A. Sedgwick said that no assistance could be looked for in the direction of embryology, and in support of this statement showed that although we regard the horses as descended from pentadactyle ancestors, the embryos show no more details of limb structure than the adult; and that although birds are admitted to have lost their teeth in the process of evolution, no rudiments of teeth are found in the embryo. He referred to the profound modification of embryonic development which varying amounts of yolk in the egg may cause; and he doubted whether any of the extinct forms known to us ought to be considered as ancestors of existing forms. He would like to see all the lines of the genealogical tree running down to the Pre-Cambrian without joining. Prof. Hubrecht also spoke on behalf of the embryologists, and pointed out that the one great distinction between the Ichthyopsida on the one hand, and the Sauropsida and Mammalia on the other, was the presence of the amniotic envelope in embryos of the latter and its absence in the former. Our ignorance of the development of the extinct forms prevented him from accepting the doctrine of descent as propounded by palæontologists. He referred to Prof. Hill's discovery of a definite deciduous placenta in *Perameles*, and to the less complete placenta of *Phascolarctos*, and concluded by expressing his doubts as to the intermediate position occupied by the Marsupials between the Monotremes and the Placental mammals.

Prof. Newton said that he took a more hopeful view of the question than the last two speakers, and that he looked in the direction of comparative anatomy and palæontology, rather than embryology, for the solution of the problem of the "Origin of Mammals."

In the afternoon at the Senate House the honorary degree of Doctor of Science was conferred on several members of the Congress and of the Congress of Physiologists. The speeches delivered by the Public Orator upon this occasion are printed at the end of this report. Prof. Kowalevski, whom it was also proposed to honour, was unfortunately prevented from attending the Congress.

A paper on "Fishery Statistics," by Prof. McIntosh, was read in Section B.

On *Friday* morning, Prof. Haeckel, discoursing on "The Descent of Man," said that the monophyletic origin of all Mammalia from the Monotremata upwards to Man is at present no more a vague hypothesis, but a positively established fact. All the living and extinct Mammalia which we know, are descended from one single ancestral form, which lived in the Triassic or Permian period; and this form must be derived from some Permian or perhaps Carboniferous reptile (allied to the Progonosauria and Theriodontia), and the latter from a Carboniferous Amphibian (Stegocephalia). These latter are descended from Devonian fishes, and these again from lower Vertebrates. Much more difficult is the question of the origin of the great Vertebrate-Stem, and its descent from Invertebrates. But these questions are not so important as the fact that Man is a member of the Primate-Order (Linné), and that all Primates descend from one common stem (Huxley). Zoology may be proud to have proved this fact, based on the theories of Lamarck (1809) and of Darwin (1859).

Prof. Marey explained why the subject of animal locomotion could not be investigated from the physiological standpoint only, but that a minute study of comparative anatomy was also essential. He exhibited numerous instantaneous photographs of horses in successive phases of movement.

Mr. W. L. Duckworth gave an account of the anatomical researches he is at present making on the Gorilla and other Anthropoid apes.

M. E. Dubois made some "Remarks on the brain-cast of *Pithecanthropus erectus*." He called attention to the scaphocephalic nature of the skull, and the consequent narrowness of the frontal region of the brain and the strong impressions of the frontal convolutions on the interior of the calvarium. The author repudiated the suggestion that the skull was a microcephalic anomaly. The femur which was found associated with the skull suggested bipedal locomotion, but there were indications in that bone of an arboreal habit such as are not found in the human femur. He showed how by comparison of human thigh bones with known corresponding body-weight he had estimated from the size of the femur of *Pithecanthropus* that its body-weight must have been 70 to 75 kilos. He then deduced the size of the whole brain (850 c.c,) from that of the internal cast of the calvarium, and from this the weight of the brain (750 grams). His ultimate conclusion was that in a man, an anthropoid ape and a *Pithecanthropus* of the same body-weight, the brain of *Pithecanthropus* would be twice as large as that of the ape, and half the size of that of the man.

In the afternoon in Section A, Prof. MacBride read a paper on the "Origin of Echinoderms." He pointed out that the type of larva common to the Asteroids, Ophiuroids, Echinoids, and Holothuroids probably represented a free-swimming bilateral ancestor of simple organisation. The main object of his paper was to consider the transformation of the bilateral into the radial form. Since the right water-vascular rudiment remained small, a main factor in the metamorphosis was the unequal development of the two sides. Where, as in Crinoids, a fixed stage succeeded the pelagic stage, bilateral symmetry ceased to be of importance to the animal; but a radial arrangement of external organs was advantageous, and hence incipient inequalities in the sides would be made use of to produce the radial arrangement.

Sir Herbert Maxwell then read a paper on "Recent Legislation on Protection of Wild Birds in Great Britain," in which he pointed out that with regard to migratory birds the question of protection was of international importance, and he referred to the recent letters in *The Times* complaining of the diminution in the number of swallows in our southern counties owing to their wholesale slaughter in the south of France. He discussed the relative merits of absolute protection in certain areas, the establishment of a close time over the whole country, and the protection of the eggs, and concluded by an account of the efforts of the Wild Birds Protection Society.

In Section B, Prof. Hubrecht gave an account of his researches on the origin of red blood corpuscles in the placenta of *Tarsius*, and explained that the corpuscles are the liberated nucleoli of proliferating syncytia of the embryonic epiblast. The genesis of red corpuscles in the placenta had previously been described in the rabbit and bat; but the discovery had not been confirmed, and the fact was not credited. The figures already published by the opponents to the view now advocated show that the appearances presented in Prof. Hubrecht's slides had previously been seen. But while these observers regarded the imperfect corpuscles visible as undergoing disintegration, Prof. Hubrecht considers them as in process of formation. In the discussion which followed, Mr. A. Sedgwick pointed out the important bearing upon the phenomenon of telegony of this introduction into the maternal blood of corpuscles derived from embryonic tissue. Prof. Hubrecht, in replying to a question by Dr. Gadow, said that he still upheld the view that *Tarsius* should, on account of the peculiarity of its placenta, be separated from the lemurs and included among the monkeys. Prof. Osborn exhibited photographs of a fossil Hyracoid from the Lower Pliocene of Samos. The specimen consists of a fairly well preserved skull contained in the Stuttgart Museum, and Prof. Osborn proposes to name it *Pliohyrax fraasii*, after Prof. Fraas, who handed over the specimen to him for description. The skull is of large size, and is twice as long as that of *Dendrohyrax*, the largest living hyrax. The dental formula is complete, viz. *i* 3, *c* 1, *pm* 4, *m* 3. The large median incisors are separated by a diastema from the other two, which are small and in continuous series with the canine and pre-molars. The first tooth in the maxilla, identified by Prof. Osborn as the canine, closely resembles in shape the anterior pre-molar immediately behind it. It has two roots and two cusps. The zygoma appears to have been extremely short, and the infra-orbital foramen is as far back as the fourth pre-molar.

Prof. Vaillant then described the minute structure of the dermal spines of the Apogonini and some other acanthopterygian fishes.

Prof. Salensky read a paper on the development of the "Ichthyopterygium." After criticising the "Archipterygium" theory of Gegenbaur and the views of Balfour and Dohrn, he explained that his own researches on the cartilages and muscles of larval specimens of the Sterlet (*A. ruthenus*) brought him in accord with the views of Mollier, and concluded that the serial rays of the fin could be correlated with certain of the primitive body-segments.

In Section C, a paper on the tapeworms of the Monotremes and Marsupials was communicated by Dr. Zschokke (Basel), who proposed to create a new genus *Linstowia* for the reception of the parasites of *Echidna* and *Perameles*. MM. Mesnil and Caullery described the discoveries made by them on the polymorphism of the sedentary Polychæte *Dodecaceria concharum*, and concluded with a discussion of the phenomenon of "épitoquie" in Annelid worms generally. Six other short papers were also read.

On *Saturday* morning, at a general meeting convened at the Guildhall, it was decided that the fifth Congress, in 1901, should be held in Germany; the selection of the town and the president to be left to the German Zoological Society, acting in conjunction with the Permanent Committee of the Zoological Congress at Paris.

The following speeches were delivered by the Public Orator, Dr. Sandys, Fellow and Tutor of St. John's College, in presenting to the Vice-Chancellor the several representatives of the International Congresses of Zoology and Physiology, on whom honorary degrees were conferred on August 25.

(1) In ipso limine laudis nostrae nihil auspicatius arbitramur, quam tot viros, de zoologiae et physiologiae studiis bene meritos, a tot orbis terrarum partibus ad nos advectos, Academiae nomine iubere salvere. Dum omnibus Collegia nostra, omnibus etiam corda nostra pandimus, unum certe animo prope fraterno contemplamur, qui a fratribus nostris transmarinis ad nos transmissus, cordis praesertim de motu reciproco et olim et nuper plurima protulit. Idem in musculorum et "nervorum" (ut aiunt) physiologiam multum inquisivit, neque psychologiae provinciam vicinam inexploratam reliquit. Huius imprimis exemplo et auctoritate factum est, ut etiam trans aequor Atlanticum physiologiae studia nunc maxime floreant, utque matris almae Cantabrigiensis filia transmarina, nomine eodem nuncupata, studiorum illorum sedes iampridem constituta sit.

Duco ad vos HENRICUM PICKERING BOWDITCH.

(2) E Germanis quidam oriundus, partris iucundi filius, laudem ideo maximam est adeptus, quia, Italiae in litore hospitali, orbis terrarum in sinu amoenissimo, vivarium Oceani spoliis reservatum gentibus patefecit, quod quasi aquarum castellum appellaverim, unde doctrinae rivuli in omnes terras late diffluxerunt. Vivarii illius conditorem inter hospites nostros diu numeravimus; eidem alumnos nostros animo laeto commendavimus; ab eodem scientia varia instructos animo grato rursus accepimus. Ipse animalium in partu praesertim explorando laboris immensi prodigus, neque minorem quam in vivario illo condendo fortitudinem ostendit, neque fortunam minus prosperam expertus est. Per totam certe vitam feliciter confirmavit verba ab ipso Plinio, historiae naturalis auctore locupletissimo, vitae suae in die novissimo prope Neapolim pronuntiata:—"fortes fortuna iuvat."

Duco ad vos ANTONIUM DOHRN.

(3) Gallorum e gente insigni, non vicinitatis tantum vinculis nobiscum coniuncta, ad litora nostra advectum salutamus, patris doctrina multiplici ornati filium, quem ipsum talium conventuum non modo praesidem primum sed etiam auctorem principem atque adeo patrem nominaverim. Avium in scientia diu versatus, etiam ex ipsis saxis avium formas latentes quam sollerter elicuit; rerum naturae museo maximo inter Parisienses praepositus, navium bene nominatarum auxilio, etiam Oceani ipsius e profundo rerum naturae veritatem quam feliciter extraxit. Quid non potuit rerum naturae,—quid non potuit veritatis amor?

"Merses profundo, pulchrior evenit."

Duco ad vos ALPHONSUM MILNE EDWARDS.

(4) Italiam, olim scientiarum matrem, laetamur nunc quoque filiis physiologiae de scientia praeclare meritis gloriari. Unum ex eis hodie salutamus, in Academia Papiensi Ticini prope ripam posita, pathologiae professorem insignem, virum etiam in eis quae oculorum aciem fugiunt observandis perspicacissimum. Idem duas praesertim ob causas in honore merito habetur: primum, quod in corpore humano fila quaedam tenuissima sensibus motibusque transferendis ministrantia, argenti auxilio per ambages suas inextricabiles exploranda et observationi subtiliori praeparanda esse docuit; deinde, quod in sanguine humano parasitis quibusdam diligenter indagatis et inter sese separatis, aëris pestilentiam propulsare, febrium cohortes profligare audacter aggressus est. Camilli mortem pestilentia absumpti Camillus alter ultus est.

Duplex certe honos viro in uno conspicitur, CAMILLO GOLGI.

(5) Germania ad nos misit non modo maris animalium minutorum investigatorem indefessum, sed etiam operis immensi conditorem audacem, in quo animalium omnium ortum ab origine ultima indagare est conatus. Ergo Caroli Darwinii, alumni nostri magni, praedicatorem inter Germanos magnum salutamus. Salutamus etiam virum, qui in ipsa rerum omnium origine recordatus omnia muta mansisse, "donec verba, quibus voces sensusque notarent, nominaque invenere," idem in ipsa animalium origine exploranda ob eam inter alias causam laudatur, quod, ingenio vivido praeditus, tot nomina nova invenerit,—quod totiens (ut Horati verbis denuo utar) "sermonem patrium ditaverit et nova rerum nomina protulerit."

Duco ad vos virum quem nominare satis est, ERNESTUM HAECKEL.

(6) Vir Batavorum inter rura genio felicissimo natus, omnium corda ad sese allexit, Europae gentium prope omnium linguas sibi vindicavit, Oceani denique monstra (ut ita dicam) minutissima et tenuissima, quae *Nemertea* nominantur, accuratissime investiganda sibi sumpsit. Illa vero monstra, si poetis Graecis licet credere, satis antiqua et memoratu satis digna esse constat. Scilicet ipse Nereus erat νημερτής τε καὶ ἤπιος, Proteus autem γέρων ἅλιος νημερτής. Sed haec utcumque sunt, in laudando viro, qui maris monstra illa forma multiplici praedita veracissime descripsit, nihil est facilius quam vera dicere, nihil iucundius quam (ut Homeri verbis utar) νημερτέα μυθήσασθαι.

Duco ad vos AMBROSIUM ARNOLDUM WILLELMUM HUBRECHT.

(7) Instituto Lipsiensi physiologiae studiosi quantum ubique debeant, doctissimo cuique satis notum. Instituti illius praesidis olim adiutor egregius, postea Borussiae, nuper Helvetiae in capite physiologiam professus est; physiologiae φαινόμενα physicis praesertim rationibus explicare conatus est; adhibito

denique instrumentorum auxilio, quae ipse aut primus invenerat aut in melius mutaverat, multa accuratius investigavit, multa prius ignota patefecit, in regiones novas scientiae suae terminos feliciter propagavit. Ob imperii tanti fines tam late propagatos lauream nostram victori felici libenter decernimus.

Duco ad vos HUGONEM KRONECKER.

(8) In provincia Palatina physiologiae professor Heidelbergensis abhinc annos plus quam triginta corporis cellularum in protoplasmate disputandi materiem satis amplam invenit; abhinc annos plus quam viginti de forma "nervorum" in musculos desinentium multum conscripsit; abhinc annos decem coram Societate Regia Londinensi de ea physiologiae provincia disseruit, in qua vitae suae quasi tabernaculum posuerat. Qui totiens unumquodque duorum lustrorum spatium laboribus suis luculenter illustravit, quasi regulam vitae Horatianum illud videtur sumpsisse :—

"servetur ad imum
qualis ab incepto processerit, et sibi constet."

Ergo etiam in posterum intra decem annos speramus physiologiae e provincia chemica fore ut talium virorum victoriis laurus plurimae referantur.

Duco ad vos WILLELMUM KÜHNE.

(9) Galliae ex Collegio Parisiensi laetamur adesse hodie historiae naturalis professorem illustrem, qui, apparatu exquisito adhibito, physiologiae quaestiones physicarum rationum ope totiens explicavit. Idem non modo cordis palpitationem alternam, sanguinis cursum continuum, musculorum denique contractionem penitus exploravit, sed etiam animalium complurium motus varios lucis ipsius auxilio feliciter illustravit. Talium virorum dignitatem contemplata, Universitas nostra non sine superbia quadam etiam in hunc virum quadrare confitebitur verba illa comoediae Gallicae celeberrimae in extremo posita :— "dignus, dignus est intrare in nostro docto corpore."

Novem virorum insignium seriem, non Senatus tantum nostri praeconio dignatam, sed etiam collegarum suorum omnium plausu comprobatam, claudit hodie professor illustris, STEPHANUS IULIUS MAREY.

Prof. Kowalevsky, the distinguished Professor of Zoology in the Imperial University of St. Petersburg, was unfortunately prevented from being present to receive the honorary degree of Doctor in Science, which it had been proposed to confer on him. In introducing the nine recipients of honorary degrees who were present, the Public Orator adopted the reformed pronunciation of Latin; and his speeches were accordingly readily understood and appreciated by the great concourse of international visitors in the Senate House.

EXPERIMENTS WITH THE TELEPHONE.[1]

EARLY estimates of the minimum current of suitable frequency audible in the telephone having led to results difficult of reconciliation with the theory of the instrument, experiments were undertaken to clear up the question. The currents were induced in a coil of known construction, either by a revolving magnet of known magnetic moment, or by a magnetised tuning-fork vibrating through a measured arc. The connection with the telephone was completed through a resistance which was gradually increased until the residual current was but just easily audible. For a frequency of 512 the current was found to be 7×10^{-8} ampères (the details are given in *Phil. Mag.*, vol. xxxviii. p. 285, 1894). This is a much less degree of sensitiveness than was claimed by the earlier observers, but it is more in harmony with what might be expected upon theoretical grounds.

In order to illustrate before an audience these and other experiments requiring the use of a telephone, a combination of that instrument with a sensitive flame was introduced. The gas, at a pressure less than that of the ordinary supply, issues from a pin-hole burner (the diameter of the pin-hole may be 0·03″) into a cavity from which air is excluded (see Fig. 1). Above the cavity and immediately over the burner, is mounted a brass tube, somewhat contracted at the top where ignition first occurs (*Camb. Proc.*, vol. iv. p. 17, 1880). In this arrangement the flame is in strictness only an indicator, the really sensitive organ being the jet of gas moving within the cavity and surrounded by a similar atmosphere. When the pressure is not too high, and the jet is protected from sound, the flame is rather tall and burns bluish. Under the influence of sound of suitable pitch the jet is dispersed. At first the flame falls, becoming for a moment almost invisible; afterwards it assumes a more smoky and luminous appearance, easily distinguishable from the unexcited flame.

When the sounds to be observed come through the air, they find access by a diaphragm of tissue paper with which the cavity is faced. This serves to admit vibration while sufficiently excluding air. To get the best results the gas pressure must be steady, and be carefully adjusted to the maximum (about 1 inch) at which the flame remains undisturbed. A hiss from the mouth then brings about the transformation, while a clap of the hands or the sudden crackling of a piece of paper often causes extinction, especially soon after the flame has been lighted.

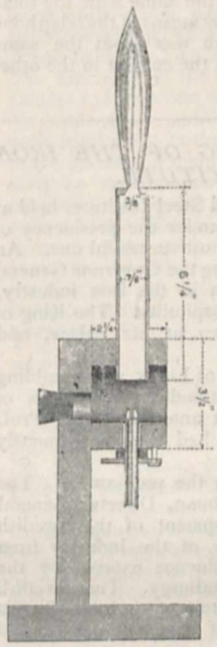


FIG. 1.

When the vibrations to be indicated are electrical, the telephone takes the place of the disc of tissue-paper, and it is advantageous to lead a short tube from the aperture of the telephone into closer proximity with the burner. The earlier trials of the combination were comparative failures, from a cause that could not at first be traced. As applied, for instance, to a Hughes' induction balance, the apparatus failed to indicate with certainty the introduction of a *shilling* into one of the cups, and the performance, such as it was, seemed to deteriorate after a few minutes' experimenting. At this stage an observation was made which ultimately afforded a clue to the anomalous behaviour. It was found that the telephone became dewed. At first it seemed incredible that this could come from the water of combustion, seeing that the lowest part of the flame was many inches higher. But desiccation of the gas on its way to the nozzle was no remedy, and it was soon afterwards observed that no dewing ensued if the flame were all the while under excitation, either from excess of pressure or from the action of sound. The dewing was thus connected with the *unexcited* condition. Eventually it appeared that the flame in this condition, though apparently filling up the aperture from which it issues, was nevertheless surrounded by a descending current of air carrying with it a part of the moisture of combustion. The deposition of dew upon the nozzle was thus presumably the source of the trouble, and a remedy was found in keeping the nozzle warm by means of a stout copper wire (not shown) conducting heat downwards from the hot tube above.

The existence of the downward current could be made evident to private observation in various ways, perhaps most easily by projecting little scraps of tinder into the flame, whereupon bright sparks were seen to pass rapidly downwards. In this form the experiment could not be shown to an audience, but the matter was illustrated with the aid of a very delicate ether manometer devised by Prof. Dewar. This was connected with the upper part of the brass tube by means of a small lateral perforation just below the root of the flame. The influence of sound and consequent passage of the flame from the unexcited to the excited condition was readily shown by the manometer, the pressure indicated being less in the former state of things.

The downward current is evidently closely associated with the change of appearance presented by the flame. In the excited state the gas issues at the large aperture above as from a reservoir at very low pressure. The unexcited flame rises higher, and must issue at a greater speed, carrying with it not only the material supplied from the nozzle, and constituting the original jet, but also some of the gaseous atmosphere in the cavity surrounding it. The downward draught thus appears necessary in order to equalise the total issue from the upper aperture in the two cases.

Although the flame falls behind the ear in delicacy, the combination is sufficiently sensitive to allow of the exhibition of a great variety of interesting experiments. In the lecture the introduction of a threepenny-piece into one of the cups of a

[1] A discourse delivered at the Royal Institution, on June 10, by the Right Hon. Lord Rayleigh, F.R.S.

Hughes' induction balance was made evident, the source of current being three Leclanché cells, and the interrupter being of the scraping contact type actuated by clockwork.

Among other experiments was shown one to prove that in certain cases the parts into which a rapidly alternating electric current is divided may be greater than the whole (see *Phil. Mag.*, vol. xxii. p. 496, 1886). The divided circuit was formed from the three wires with which, side by side, a large flat coil is wound. One branch is formed by two of these wires connected in series, the other (in parallel with the first), by the third wire. Steady currents would traverse all three wires in the same direction. But the rapidly periodic currents from the interrupter distribute themselves so as to make the self-induction, and consequently the magnetic field, a minimum; and this is effected by the assumption of opposite values in the two branches, the ratio of currents being as $2 : -1$. On the same scale the total or main current is $+1$. It was shown by means of the telephone and flame that the current in one branch was about the same (arithmetically) as in the main, and that the current in the other branch was much greater.

THE STOCKHOLM MEETING OF THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute, held at Stockholm on August 26 and 27, under the presidency of Mr. E. P. Martin, of Dowlais, was a most successful one. An influential reception committee, including the Governor General of Stockholm and all the leading men in the iron industry, entertained the members with lavish hospitality. The King of Sweden invited the members to supper at his Palace, and attended the meeting in person.

The meetings were held at the House of Lords, a fine building erected in 1648, and were largely attended. Addresses of welcome were given, and the President announced that Prof. W. C. Roberts-Austen, C.B., F.R.S., had been unanimously chosen to succeed him as President.

No less than eleven papers were on the programme. The first paper read was by Mr. R. Åkerman, Director General of the Board of Trade, on the development of the Swedish iron industry. He traced the history of the industry from the earliest times, and showed the influence exerted by the chemists Scheele and Berzelius on metallurgy. The Swedish production last year comprised 538,197 tons of pig iron, 189,632 tons of wrought iron, 107,679 tons of Bessemer ingots, and 165,836 tons of open-hearth ingots.

Prof. G. Nordenström read a paper describing the characteristic features of Swedish iron ore mining. He began with an account of the geology of the country, and then discussed the geographical distribution of the iron ores, their mode of occurrence, composition, mining and production. The total production last year was 2,086,119 tons. Much of the paper was devoted to the use of magnetic instruments in exploring for iron ore, a subject previously treated by Mr. B. H. Brough in a paper read before the Institute in 1887.

Mr. C. P. Sandberg's paper on the danger of using too hard rails, contained the results of experience on the Swedish railways. He considered that it is preferable to adopt a heavier weight of rail of moderate hardness, rather than to try to remedy the deficiency in weight of rails originally used by now resorting to a dangerous hardness of rail of the same section.

Mr. A. Greiner, director of Cockerill's works at Seraing, communicated, as a supplement to the paper he read in May, the results of experiments by Mr. A. Witz with a simplex motor, using blast furnace gas. The results were highly satisfactory, showing that the working of the 200 horse-power engine is very economical and as regular as that of a steam engine. The dust in the gas is in no way injurious to its continuous operation.

Mr. H. Lundbohm, of the Geological Survey of Sweden, described the iron ore deposits of Kiirunavaara and Luossavaara, the largest deposits in Swedish Lapland. The ore occurs in bed-like masses in porphyry. It is very rich, and the author estimates that there is above the level of the lake at Kiirunavaara 215,000,000 tons, and at Luossavaara 18,000,000. The situation of the beds within the Arctic circle at 67° 50′ north lat. renders them inaccessible. A railway, now in course of construction, from the Gulf of Bothnia to Ofoten, will give access to these deposits and furnish a most important source of iron ore supply.

Mr. J. E. Stead supplemented the important paper on the crystalline structure of iron by presenting further facts bearing upon the brittleness produced in soft steel by annealing. The most important point established is that phosphorus must not exceed 0·08 per cent.

The paper on the micro-chemistry of cementation, read by Prof. J. O. Arnold, was of special interest as giving a detailed description of the effect of cementation on the brands of iron sent by Sweden to England.

Mr. G. R. Johnson, of Embreville, Tennessee, contributed a paper on the action of metalloids on cast iron. He insisted that foundrymen in buying iron should require analysis as well as fracture, for it is impossible to judge of the composition of an iron merely by looking at it.

Prof. W. C. Roberts-Austen discussed the action of the projectile and of the explosives on the tubes of steel guns, showing the interesting results obtained by an examination of the bores of corroded guns by the aid of micro-photography. An interesting discussion followed the reading of the paper, a noteworthy contribution being supplied by Mr. Nordenfeldt.

The two other papers on the list were taken as read. Baron H. Jüptner applied the data as to the thermal relations of iron carbon alloys contained in Prof. Roberts-Austen's fourth Report to the Alloys Research Committee of the Institution of Mechanical Engineers, to correcting the conclusions expressed in his paper on the solution theory of iron and steel read last May. And Prof. E. D. Campbell, of the University of Michigan, described some further experiments made by him on the diffusion of sulphides through steel.

The usual votes of thanks were given, and the meeting terminated.

An elaborate programme of excursions was arranged. Various works in Stockholm were visited. Before the meeting a limited number of members visited the remarkable iron mines of the Arctic Circle, and after the meeting there were two excursions occupying several days: one to the ironworks of Domnarfvel, Hofors, Sandviken, and the mines of Grängesberg, Falun, and Dannemora; and the other to the ironworks of Laxå, Degerfors, Bofors, Uddeholm and Storfors, and to the Persberg iron mine. All the arrangements were most satisfactory, and great credit is due to the Hon. Secretary of the Reception Committee, Mr. J. C. Kjellberg, and to Mr. Brough, the Secretary of the Institute.

THE OLD BEDS OF THE AMU-DARIA.

THE Russian Geographical Society has just issued a new volume which contains an important contribution to the much debated question as to the old beds of the Amu-daria. It is written by the mining engineer, A. M. Konshin, and contains a geological map showing the extension of the Pliocene and modern Caspian deposits, as well as of the Loess and the fluviatile deposits in the Transcaspian region, and a number of drawings of dunes and *barkhans* (of aeolic origin), and small plans of the Uzboi and the Ungus (supposed old beds of the Amu).[1]

When the Transcaspian region was first opened to scientific exploration it was generally believed that the ravine which runs from Lake Aral to the Caspian Sea, the Uzboi, as well as the Ungus and the Kelif Uzboi, represent old beds of the Amu, which, continually shifting its bed towards the right, ran successively at the foot of the Kopet dagh, then across the Karakum desert, and finally, after having taken to its present bed, sent a branch towards the Caspian Sea along what is now known as the Uzboi. This hypothesis has still a fervent adherent in Baron Kaulbars. A further exploration of this region, which was made in 1883, proved, however, that the Uzboi has not the characters of an old river bed, and that in Post-Pliocene times the Caspian Sea sent a broad gulf eastwards, into what is now the Karakum desert. The Ungus, which crosses this desert, is also not an old bed but an escarpment by which the Pliocene clays of the Karakum Plateau fall towards the lower-lying Post-Pliocene Karakum Sands. Consequently, two hypotheses are now in presence. One of them, supported by M. Konshin, is that a gulf of the Caspian stretched as far eastwards as the longitude of Merv, sending in its western part a branch northwards, along the Uzboi, as far as the

[1] "Contribution to the Question relative to the Old Course of the Amu-daria." 256 pp. with several maps and drawings. St. Petersburg, 1897. (*Memoirs of the Russian Geographical Society*, General Geography, vol. xxiii. part 1). Russian.

Sarykamysh lakes. When this gulf began to desiccate, the Amu began to flow northwards, in its present bed. The other hypothesis, developed with great skill by M. Obrucheff ("The Transcaspian Lowlands," 1890), is that the Karakum gulf existed and received the Amu with its tributaries, the Murghab and the Tejen; when the gulf began to desiccate the Amu continued to flow that way and entered the Caspian, and only later began to flow northwards, sending a branch along the Uzboi.

In his new volume M. Konshin discusses this hypothesis in detail, and gives his arguments in favour of his own views. His chief arguments are, first, that the Caspian shells, belonging to species now living in that sea (*Dreissena*, *Hydrobia*, *Neretina*, and *Lithoglyphus*), are found in the southern parts of the Uzboi, uncovered by deposits of fluviatile origin, as also at the western entrance of the Karakum Gulf, where they are found at elevations of from 140 feet to (at least) 175 feet, and occasionally 280 feet, above the present level of the Caspian; and next, that the Karakum Sands bear no traces of fluviatile deposits or of the levelling action of water which would be apparent in case the Karakum Gulf had harboured a river after its desiccation. The hillocks, 150 feet to 250 feet high, which cover these sands, are marine dunes, and the elongated depressions filled with salt water (*shors*), which are considered as indicative of old river beds, have nowhere the regularity which old river beds would be possessed of. They are traces of a retreated sea.

It is evident that further exploration is wanted; but it must be acknowledged that the absence of river deposits in the Karakum Sands militates in favour of M. Konshin's views. P. K.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. R. B. OWENS, of the Nebraska University, has been appointed to the McDonald chair of Electrical Engineering in the McGill University, Montreal.

THE following appointments have been made in the School of Agriculture, Ghizeh, Egypt:—Senior Professor of Agriculture, Mr. H. J. Monson, lecturer on agriculture and horticulture at the Yorkshire College, Leeds; Junior Professor of Agriculture, Mr. Andrew Linton, B.Sc. (Hons.), Durham University.

THE 1898-99 programme of technological examinations conducted by the City and Guilds of London Institute has just been published by Messrs. Whittaker and Co. The contents comprise syllabuses of the seventy subjects in which examinations are held, and copies of the papers set at this year's examinations. At the end of the syllabus of each subject is a list of works of reference, which must prove of great service to both teachers and students.

THE doctorates conferred by universities in the United States in 1897 are classified in *Science*, with the view to comparing the tendency of the work of the students. It is pointed out that the American university is definitely a place for research, where both teachers and students are engaged in research or in learning the methods of research. The results of the work of the students is, therefore, in large measure summarised by the theses for the doctorate, and it is interesting to know what is the outcome of the past year's research. It appears from the classified list referred to that eighteen leading universities conferred the Ph.D. degree on 234 candidates. Of this total number, no less than 105 degrees were conferred for scientific theses. The Humanities came next with 91 degrees, while History and Economics numbered only 38 degrees.

THE reports of inspectors on schools and classes under the Department of Science and Art, contained in the forty-fifth annual report of the Department, show that the teaching of science in the Government schools is undergoing distinct improvement. In the schools of science inspection has entirely taken the place of examination, at any rate in the elementary course, and this, by relieving the teacher of the strain entailed by preparation for examination at a prescribed date, has tended to sounder and more satisfactory work. It is being gradually realised that a school of science should be characterised more by a systematic course of study than by the mere possession of laboratories and apparatus. In classes in physics and chemistry a decided improvement in the methods of teaching is reported. Apparatus is more freely used than formerly, the teaching is less mechanical, and increased attention is being given to practical work. There can be no doubt that the practical instruction in these and other science subjects adds enormously to the value of the theoretical lessons, and it is to be hoped that the number of schools arranging for such work will increase year by year.

THE coordination of the work of the class-room and laboratory was the subject of a paper read by Prof. Gaetono Lanza, Professor of Applied Mechanics, Massachusetts Institute of Technology, at the recent annual meeting of the American Society for the Promotion of Engineering Education. Prof. Lanza insisted that pure science and literature should not be neglected in an engineering education, and he pointed out that to impart to the student a thorough mastery of scientific principles far outweighs in importance anything else that can be done for him, and this is the chief function of an engineering course. The class-room work forms the basis of the course; and the laboratory work, to serve its purpose, must be based upon the class-room work which has preceded it, must be thoroughly coordinated with it, and must be made to depend upon it, to use it, and to serve as an aid to illustrate the principles involved. The functions of the engineering laboratory are partly to emphasise and illustrate the work of the class-room, partly to drill the students in performing carefully and accurately such experimental work as they are liable to be called upon to perform in the practice of their professions, and partly to teach them to carry on experimental investigation. In order to fulfil these purposes there should be an intimate relation between the class-room and the laboratory work, and the student should be made to work up the results of the tests in the light of what he has learned in the class-room. Prof. Lanza concluded by expressing the view that any organisation which does not tend to preserve the most intimate relation between the two, is not for the best interests of the student and should not exist.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, vol. iv. No. 10, July.—The structure of the hypoabelian groups, by Dr. L. E. Dickson, gives a marked simplification both in the general conceptions and in the detailed developments of the theory of the two hypoabelian groups of Jordan and of the author's generalisation ("the first hypoabelian group generalised," *Q. J. of Mathematics*, 1898), to the Galois field of order 2^n of the first group. It is important, for the generalisation, to give these groups an abstract definition independent of the theory of "exposants d'échange," by means of which Jordan derived them. The crucial point in the simplified treatment lies in the discovery of the explicit relations

$$\sum_{i,j}^{1\ldots m} a^{(i)} \delta_j^{(i)} = m, \sum_{i,j}^{1\ldots m} a_j^{(i)} \delta_j^{(i)} + \alpha'_1 + \beta'_1 + \gamma'_1 + \delta'_1 = m,$$

satisfied by the substitutions of the simple sub-groups J and J_1, respectively, but ruling out the remaining substitutions of the total hypoabelian groups G and G_1. The paper was read in abstract at the Chicago meeting, April 9.—The following five papers were read at the meeting of the Society held on April 30 (for an account of five other papers read at the same meeting, see vol. lviii. No. 1500, p. 310).—On the Hamilton groups, by Dr. G. A. Miller. Dedekind's definition of such a group is that it is a non-Abelian group, all of whose sub-groups are self-conjugate. If the order of such a group is $p_1^{a_1} p_2^{a_2} p_3^{a_3} \ldots$ ($p_1, p_2, p_3 \ldots$ being prime numbers) it must be the direct product of its sub-groups of orders $p_1^{a_1}, p_2^{a_2}, p_3^{a_3}, \ldots$ since each of these sub-groups is self-conjugate, and no two of them can have any common operator except identity (*Math. Annal.*, vol. xxii. p. 97). Each of these sub-groups is either Abelian or Hamiltonian. Dr. Miller proceeds to show that one of the given prime numbers must be 2, and that every sub-group whose order is a power of any other prime number must be Abelian. The results are conveniently summarised at the end of the short paper.—Note on the infinitesimal projective transformation, by Prof. E. O. Lovett. The writer proposes to find the form of the most general infinitesimal projective transformation of ordinary space directly from its simplest characteristic geometric property. Geometrically, these transformations are those infinitesimal point transformations which transform a plane into a plane, *i.e.* which leave invariant the family of ∞^3 planes of ordinary space.—Prof. Lovett contributes a further note on infinitesimal transformations of concentric conics. He defines a family of curves to be invariant under the transformations of a continuous group of transformations when the family is invariant under the infinitesimal transformations which generate the group A family is invariant under an infinitesimal transformation when the differential equation of the family admits of the infinitesimal transformation. He states the criterion, and points out that the converse problem is an integration problem not capable of general solution.—A solution of the biquadratic by binomial resolvents, by Dr. G. P. Starkweather, claims to be a new solution in which the roots are given explicitly, and to be an interesting application of Galois' methods.—Mr. H. E. Hawkes, in "Limitations of Greek Arithmetic," discusses the number system of the Greeks, and shows how their arithmetical notions were limited by their geometrical symbolism. The argument is mainly based on Euclid's Elements.—There are some further notes: viz. note on special regular reticulations, by Prof. E. W. Davis. In his remarks on maxima and minima of functions of several variables, Prof. J. Pierpont points out a flaw in the treatment of this theory in the treatises of Todhunter, Williamson and Byerly, and calls attention to the results of Scheefers, Stolz and von Dantscher, which find a place in the Cours d'Analyse of M. C. Jordan.—On the intersections of plane curves, by F. S. Macaulay, discusses further some interesting points raised in Miss Scott's paper on Mr. Macaulay's "point groups in relation to curves" (of March number of the *Bulletin*).—In addition to four minor notices and reviews, and the notes, index, &c., there is a list of the papers read before the Society, with references to the journals in which they have been published.

American Journal of Science, August.—The origin and significance of spines, Part 2, by C. E. Beecher. Most organisms have certain parts which are more exposed to the forces of the environment than others, and such exposed parts, when acted upon by hereditary requirements, produce the various external organs and appendages. When such a hereditary predisposition is absent, the normal responsive action between growth and stimulus tends to produce a conical or spiniform growth. Other conditions favourable to the development of spines are restraint of environment, causing suppression of highly developed structures, and deficiency of growth force, causing degeneration of organs, such as leaves into spines representing the mid-rib, branches into spiniform twigs, legs or digits into spines.—The prehistoric fauna of Block Island as indicated by its ancient shell-heaps, by G. F. Eaton. Block Island is situated off the New England coast, to the east of Long Island. Three ancient shell-heaps were explored, which yielded valuable finds. Bones of the great auk were found in two of them, and in one, part of the skull of the grey seal. The human remains discovered show little variation from the type of the New England Indian. The remains of a child show distinct traces of a violent death, and the absence of the arms and a portion of the lower limbs points to the practice of cannibalism. Stone implements were also discovered, and some highly finished articles made of bone. The fauna generally is of a continental character, and indicates a former connection of the island with the mainland.—A registering solar radiometer and sunshine recorder, by G. S. Isham. Two barometer tubes are suspended by the arms of a balance. They contain mercury and saturated alcohol vapour. One of them is blackened and exposed to sunlight, which increases the pressure of the alcohol vapour and expels some mercury. The motion of the beam is recorded by a pen travelling across a divided scale moved by clockwork.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 22.—M. Wolf in the chair.—Observations of the planet 1898 DQ (Witt, 1898 August 14), made at the Paris Observatory, by M. Jean Mascart. The magnitude of the planet in question is about 10·5. Its apparent position was determined six times between August 18 and 20.—On the groups contained in motion of any kind, by M. G. Ricci.—Melting points of some substances under high pressures, by M. E. Mack. The apparatus used gave a range of pressure from 150 to 2140 atmospheres, and fourteen determinations of the melting-point of naphthalene were made at pressures between these two extremes. The results could be expressed with sufficient accuracy by the formula $t = 79{\cdot}8 + 0{\cdot}0373\,p - 0{\cdot}0000019\,p^2$, and the last term being very small, the increase in the melting-point is nearly proportional to the pressure. Measurements were also made with α-naphthylamine, diphenylamine, and paratoluidine, the results generally lying on a straight line, no indications being obtained of the maxima noticed by previous experimenters.—On the oxides of sodium, by M. de Forcrand. By heating sodium in a slow current of dry air, a greyish suboxide of sodium is formed, having the composition Na_3O. This, however, could not be obtained pure and unmixed with sodium. Further treatment with air gives Na_2O and Na_2O_2, but the former could not be obtained even approximately pure.—On the ammoniacal chlorides of lithium, by M. J. Bonnefoi. Pure dry LiCl, kept at a temperature above 85°, absorbs ammonia, giving $LiCl.NH_3$, the dissociation pressures of which were measured at four temperatures. The application of Clapeyron's formula to these measurements gave a value for the latent heat of dissociation in close agreement with that found experimentally. Between 60° and 85°, $LiCl2NH_3$ is formed; between 20° and 60°, $LiCl3NH_3$; and at 13°, $LiCl4NH_3$. In all cases the results given by Clapeyron's formula agreed well with the direct thermochemical data.—The estimation of tannin, by M. Leo Vignon. The tannin is absorbed from solution by silk, and the loss determined either by drying at 110°, or by titrating the solution with permanganate. Test analyses show a good agreement with those obtained by methods previously used (Sisley, Aimé Girard).—On the composition of phosphorescent sulphides of strontium, by M. J. R. Mourelo. The phosphorescent sulphide contains small proportions of strontium sulphate, sodium sulphide and chloride, and bismuth sulphide and oxide; and the presence of these impurities appears to be a necessary condition for a brilliant and lasting phosphorescence.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Zoological Results based on Material from New Britain, &c., collected during the Years 1895, 1896, and 1897, Part 1: Dr. A. Willey (Cambridge University Press).—City and Guilds of London Institute Programme of Technological Examinations, Session 1898–99 (Whittaker).—Geology for Beginners: W. W. Watts (Macmillan).—Plant Life: Prof. C. R. Barnes (N.Y., Holt).—Special Report on the Beet-Sugar Industry of the United States (Washington).

PAMPHLETS.—Deductive Series of Arithmetical Problems, Standards 3 to 7 (Reading, National Publishing Association, Ltd.).—Mines and Quarries: General Report and Statistics for 1897. Part 2. Labour (Eyre).

SERIALS.—Good Words, September (Isbister).—Sunday Magazine, September (Isbister).—English Illustrated Magazine, September (198 Strand).—Chambers's Journal, September (Chambers).—Longman's Magazine, September (Longmans).—Century Magazine, September (Macmillan).—Atti del Reale Istituto d'Incorraggiamento di Napoli, 4te serie, Vol. x. (Napoli).—Johns Hopkins University Studies, ser. xvi. Nos. 7, 8, 9 (Baltimore).—Natural Science, September (Dent).—Contemporary Review, September (Isbister).

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