THURSDAY, DECEMBER 30, 1875

MONTEIRO'S ANGOLA

Angola and the River Congo. By Joachim John Monteiro. Two vols., with map and illustrations. (London: Macmillan and Co., 1875.)

ALTHOUGH Angola is one of the oldest, if not the oldest, European colony in Africa, there are probably few other discovered regions in that continent about which English readers at least know so little, and we suspect that the Portuguese themselves know even less about its people, its productions, and its physical geography. And yet it is about four hundred years since the Portuguese planted their first colony on the coast. True there are a number of memoirs of old date, in Portuguese and in English, relating to the country, including the narrative of quaint Andrew Battell, who was for years a prisoner in Angola; but these are all pre-scientific. Recent travellers have told us a good deal about the lower Congo, and Burton, as we recently noticed, made brief visits to some of the Portuguese settlements further south, and in his own way has told us much worth knowing. Henceforth, however, there can be no doubt that Mr. Monteiro's work will be regarded as the authority on the country, more especially when it is supplemented by the various memoirs on the natural history of Angola which he has contributed to the proceedings of the Linnean and other societies, and to scientific journals. Mr. Monteiro spent many years in the country, evidently in connection with mining operations, and during that time had opportunities of visiting and exploring most if not all of the principal districts from the Congo to Mossamedes, frequently penetrating many miles inland. Mr. Monteiro is an Associate of the Royal School of Mines, and his work proves him to be well qualified not only for geographical exploration, but for the investigation of the natural history and physical conditions of a country. He is evidently quite at home in geology, zoology, botany, and meteorology, and has a skilled eye for the points which a traveller ought to note in the natives whom he visits. To the natural history of the country, our naturalist readers no doubt know, Mr. Monteiro has made several important contributions. On the Portuguese settlements and colonists, on the various native tribes, on the geographical and physical features, and on the natural history of Angola the work before us contains such abundant information, that no one but a specialist need go further to obtain a satisfactory knowledge of the country in all its aspects. Mr. Monteiro writes in a simple, straightforward style, indulges but little in speculation, conjecture, or moralising, and every page is so full of interesting and important facts, clearly told, that the reader will feel constantly in a state of satisfied enjoyment. Most of the information in the work has been obtained at first hand; in the few instances where it is otherwise Mr. Monteiro is careful to point out the source and its value. So far as a full and trustworthy account of Angola is concerned, it seems to us that it would be difficult to supersede the work before us.

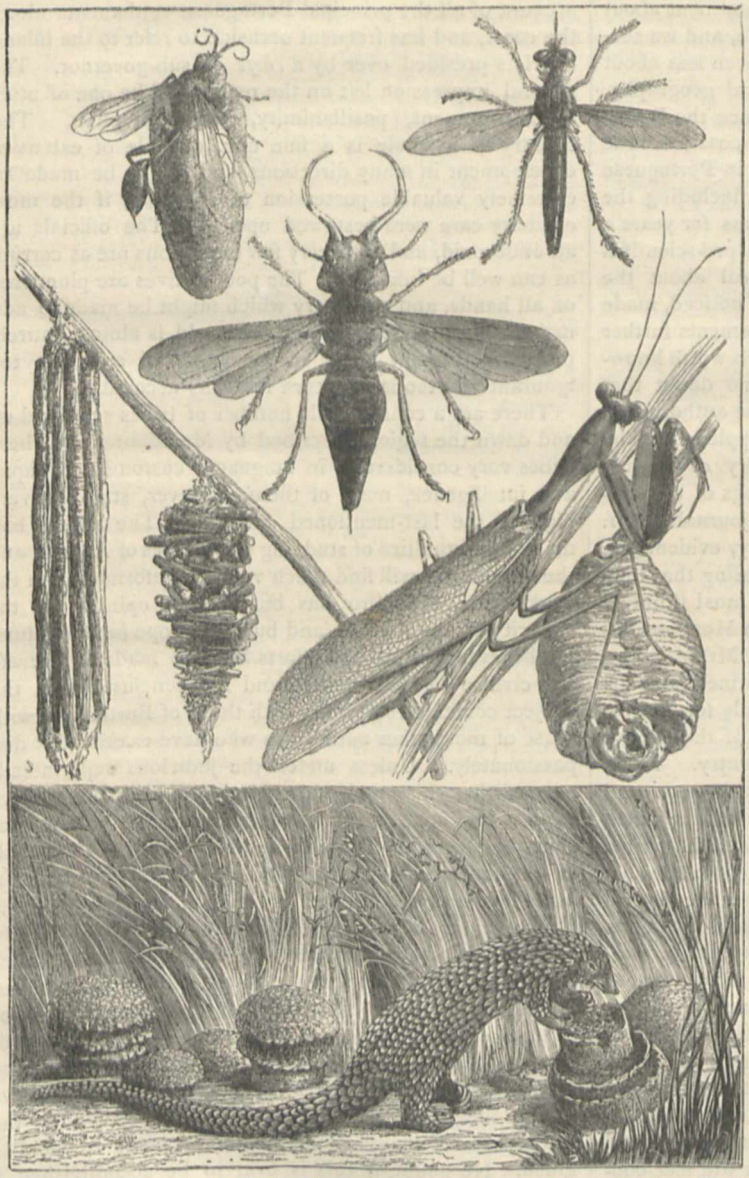
The name Angola Mr. Monteiro applies to all the country from the Congo to Mossamedes, a distance of about nine degrees of latitude. On the north, however, the Portuguese possessions extend no farther than Ambriz, a good many miles south of the Congo, while on the south they extend as far as Cape Frio in 18° 20′ S. lat. The author chooses the Congo as the northern boundary, that being the strong natural limit of the climate, fauna, and ethnology of the region. Chapter I. contains a brief account of the history of Angola to the beginning of the present century, translated from the Portuguese of Feo Cardozo. Throughout the work Mr. Monteiro gives an account of all the principal Portuguese settlements along the coast, and has frequent occasion to refer to the inland districts presided over by a *chefe* or sub-governor. The general impression left on the reader will be one of utter mismanagement, pusillanimity, and oppression. The country as a whole is a fine one, capable of extensive development in many directions, and might be made an extremely valuable possession to Portugal, if the most ordinary care were bestowed upon it. The officials are all underpaid, and with very few exceptions are as corrupt as can well be imagined. The poor natives are plundered on all hands, and a country which might be made to add materially to the resources of the world, is almost entirely profitless through being in the hands of a people too ignorant and too lazy to turn it to any account.

There are a considerable number of tribes scattered up and down the region described by Mr. Monteiro. These tribes vary considerably in language, customs, physique, and intelligence, none of them, however, standing very high in the last-mentioned attribute. The author had many opportunities of studying the natives of Angola, and the ethnologist will find much valuable information in the work. Mr. Monteiro has but a poor opinion of the capacity of the African, and but little hope for his future. He believes that all the efforts hitherto made to elevate and civilise him have failed, and his conclusions on the subject coincide essentially with those of Burton and with those of most other authorities who have examined it dispassionately. Unless under the judicious superintendence of the white man, Mr. Monteiro does not believe there is any hope of the negro ever attaining to any considerable degree of civilisation; and as whites can flourish in very few parts of Africa, "the negro must ever remain as he has always been, and as he is at the present day." Moreover, any advantages which the negro has hitherto derived from the white races have been more than counterbalanced "by the creation of an amount of vice and immorality unknown to the negro in his native or unsophisticated state." Many, no doubt, will be inclined to think that Mr. Monteiro takes much too hopeless a view of the future of Africa and Africans. It is certainly hard to believe that no means will ever be discovered of developing the resources of a country which might be made to yield so much. No doubt, if this is ever to be accomplished, it must be mostly by means of native labour under white superintendence. But with the author's general conclusions on the African question we have no doubt that all who have dispassionately considered must in the main agree. Angola itself is on the whole a comparatively healthy region, and, with ordinary care, Europeans need have little difficulty in getting acclimatised. On this subject, Mr. Monteiro gives some valuable hints; he is of the same opinion as Capt. Burton as to the use of stimulants in tropical countries; from his own experience and from observa-

tions, he infers that their judiciously moderate use is indispensable to complete health.

With regard to the almost hopeless stupidity of the negro, the author gives a curious instance. He employed a number of natives while mining malachite at Bembe. He says :—

"It was great trouble to teach the natives the use of the pick and shovel, and the wheelbarrow was a special difficulty and stumbling-block ;—when not carrying it on their heads, which they always did when it was empty, two or three would carry it ; but the most amusing manner in which I saw it used, was once where a black was holding up the handles, but not pushing at all, whilst another in front was walking backward, and turning the wheel round towards him with his hands."



Pelopæus spirifex and nest—Devil of the road (*Synagris cornuta*)—*Dasylus sp.*—Caterpillars' nests—Mantis and nest—*Mantis multisentatum* and Ants' nests.

The following bold and ingenious theory as to the character of the native Africans is at least worthy of consideration :—

"The character of the negro is principally distinguished not so much by the presence of positively bad, as by the absence of good qualities, and of feelings and emotions that we can hardly understand or realise to be wanting in human nature. It is hardly correct to describe the negro intellect as debased and sunken, but rather as belonging to an arrested stage. There is nothing inconsistent in this ; it is, on the contrary, perfectly consistent with what we have seen to be their physical nature. It would be very singular indeed if a peculiar adaptation for resisting so perfectly the malignant influences of the climate of tropical Africa, the result of an inferior physical organisation, was unaccompanied by a corresponding inferiority of mental constitution. It is only on the theory of 'Natural Selection, or the survival of the fittest' to resist the baneful influence of the climate through successive and thousands of generations — the 'fittest' being those of greatest physical insensibility — that the present fever-resisting, miasma-proof negro has been produced, and his character can only be explained in the corresponding and accompanying retardation or arrest of development of his intellect."

In his second chapter the author gives a very clear account of the physical conditions of Angola, whose aspect, productions, and climate present considerable variety both north and south, and from west to east. Contrary to the generally received opinion, Mr. Monteiro doubts whether the Congo, with its vast body of water and rapid current, drains any large extent of country in an easterly direction to the interior, beyond the first rapids. He is inclined to believe that the river, or its principal affluent, after going in a N.E. direction for a comparatively short distance, bends to the southward and will be found to run for many degrees in that direction. It would be vain to theorise on the question, which happily may be set at rest by Lieut. Cameron, who is expected to arrive in this country in a week or two ; the information he must have obtained about the watersheds between the Zambesi and the Congo may enable us to form some notion of the upper course and approximate length of the river. Mr. Monteiro's general conclusion seems, however, at present a very probable one. "From the few and insignificant streams traversing Angola to the coast, which at most only reach sufficiently far inland to have their source at the third elevation or central plateau, it would seem that a great central depression or fall drains the waters of this part of Africa in either an easterly or southerly direction."

The alternation of swamp and dense forest which is characteristic of so much of the West Coast of Africa, ends completely on arriving at the River Congo, and a total change, Mr. Monteiro tells us, to the comparatively arid country of Angola takes place.

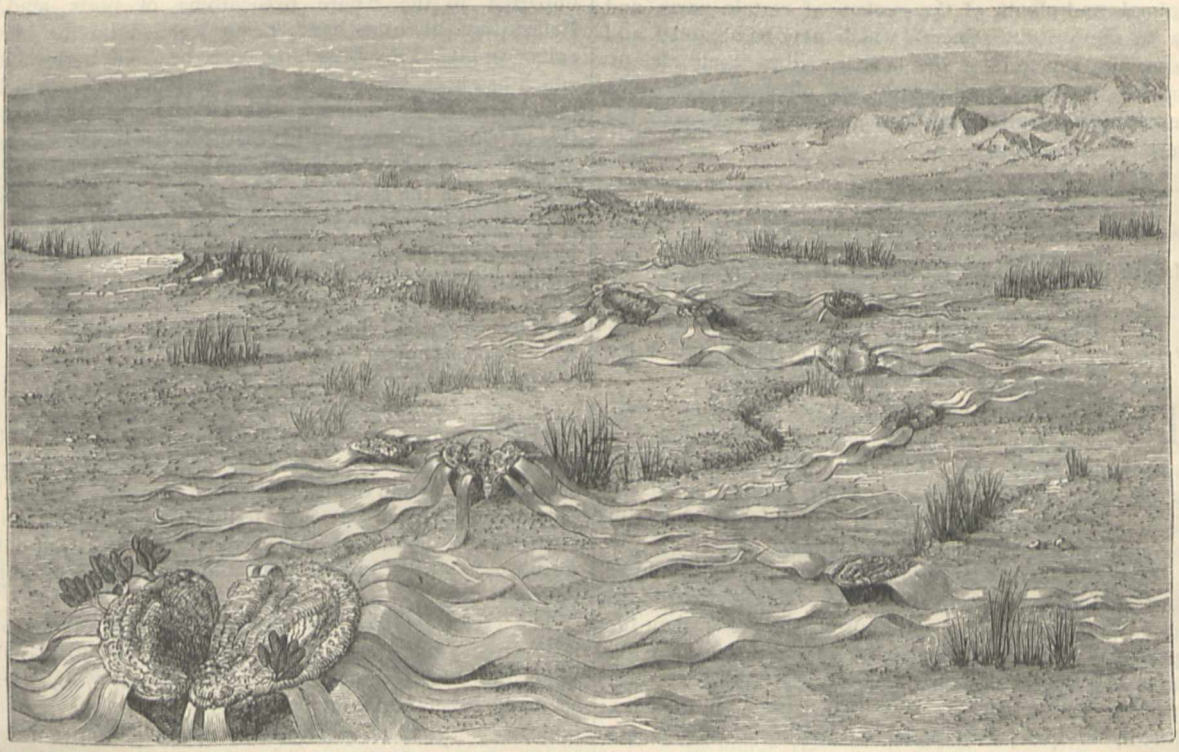
"I may say that, without exception, from the River

Congo to Mossamedes no dense forest is seen from the sea, and from thence not a single tree, it is said, for hundreds of miles to the Orange River. A little mangrove, lining the insignificant rivers and low places in their vicinity, is all that varies the open scrub, of which the giant Adansonios and Euphorbias have taken, as it were, exclusive possession. Nowhere on the coast is seen more than an indication of the wonderful vegetation, or varied beauty and fertility, which generally begins at a distance of from thirty to sixty miles inland.

"At this distance, a ridge or hilly range runs along the whole length of Angola, forming the first elevation; a second elevation succeeds it at about an equal distance; and a third, at perhaps twice the distance again, lands us on the central high plateau of Africa."

Each of these successive elevations is accompanied by a corresponding change in the character of the vegetation. This varied vegetation Mr. Monteiro describes with considerable minuteness as he makes his way from the Congo to Mossamedes, stopping at many places to make minute explorations of the country around. As we have said, Mr. Monteiro has chosen the Congo as the northern boundary of Angola, because it presents a well-marked line of division in respect of climate, fauna, nature, and customs, between Angola and the rest of the west coast. He refers to some very remarkable facts in confirmation of this. The Congo is the southern limit of the gorilla and of several species of monkeys and even of birds, butterflies, and insects. He says truly that it would well repay a naturalist to investigate the number of species the Congo cuts off; it is a pity he had not time to undertake the work himself; no one could be more competent.

With regard to the universal fetishism of the natives,



Welwitschias growing in a plain near Mossamedes.

Mr. Monteiro gives abundant information, much of which we are sure will shed a new light on this degrading and depressing superstition. It seems almost impossible to eradicate it. Many of the Angolan tribes were converted and educated by the old Portuguese missionaries, and to this day many of the tribes transmit the "trick," as Mr. Monteiro calls it, of reading and writing. But this seems to have had no effect in abolishing fetishism, but on the contrary has rather furnished it with new materials on which to flourish. In some respects fetishism seems to resemble the Polynesian "tabu." "Fetish" is often used as equivalent to *charm* or *magic*, and many objects are used by the natives to carry about with them to be used as charms against evil, and in some places rude houses are built as a dwelling for a fetish, who may be represented by a rude image. But besides this it is possible to fetish a person, or thing, or animal, in the same way as in some of the Pacific Islands certain objects may be tabu. Certain animals are fetish, and these a native dare not injure; and indeed it seems possible and easy to render anything whatever fetish, and once at least Mr. Monteiro took legitimate advantage of the custom for his own protection. Their fetishes have, however, no power for good or evil over the white man, who belongs to another and more powerful god than do the natives, who themselves received the idea of God or Creator from the Portuguese missionaries.

The Celis and Mucelis, tribes dwelling inland from Nova Redondo to the north of Benguella, are, Mr. Monteiro believes, the only cannibals in Angola; the Quinbundos, a superior tribe to the south of the Quanza, are not so, "though a traveller who made a few days' trip up the river has asserted they are." The natives on the Quanza and to the south for many miles are great bee-

keepers, constructing hives which they keep in trees. Some families possess as many as 300 or 400 hives.

About Mossamedes the *Welwitschia mirabilis* is found growing, and the country about the river San Nicolau, 14° S. lat., seems to be its northern limit. Mr. Monteiro sent home specimens of the plant, flower, and cones, which supplied Dr. Hooker with some of the materials for his monograph on the plant.

It is impossible in our limited space to give any adequate idea of the abundant information contained in these volumes; we can only assure our readers that if they wish for satisfactory information about the country, the people, the fauna, the flora, the geology, the mineralogy of Angola, they will find it here. While an excellent idea of the country as a whole will be obtained, the author gives minute details of a very large number of animals and plants, of the geology of certain parts, and as to the various minerals which may be obtained, and especially concerning the various tribes, their characteristics, customs, implements, and other matters. The numerous illustrations add not a little to the value of the work.

WORKS ON THE BLOWPIPE

An Introduction to the Use of the Mouth-Blowpipe. By Dr. Theodore Scheerer and H. F. Blanford, F.G.S. Third Edition. (London: Frederick Norgate, 1875.)

Pyrology; or, Fire Chemistry. By Major W. A. Ross, R.A. (London: E. and F. N. Spon, 1875.)

THE first of these volumes is a third edition of a well-known little work, the second edition of which was published in 1864. We think that it still holds its place as the best elementary book on the application of the blowpipe to the determination of minerals, although but few changes have been made in the text.

Major Ross's work on "Pyrology" is an imposing volume illustrated with coloured lithographs. The preface looks more like an article in a well-known daily paper than the opening of a scientific treatise, for in the space of a few pages the names of Neri, Cassius, Pattinson, Herbert Spencer, Bacon, Sir W. Hamilton, Hume, Kant, Mrs. Marcet, Walpole, Bonaparte, Grimaldo, and Hook are alluded to, often in a flippant and tiresome way. The introduction is much in the same style, and we are told that "precisely the same operations of the mind are necessary to analyse a murder or a miracle as a mineral," and that "the general, the detective or the logician deduces probabilities from facts . . . and the physicist or pyrologist has first to elicit facts, which he calls reactions, from which probabilities are concluded." A passage which occurs on page 10 deserves notice. In it the author states that "the various spectra in the orange, green, violet, and indigo, &c., are due to the vapour of substances composed of combinations of hydrogen, oxygen and carbon, and thus that such lines seen in the solar spectrum should scarcely without further evidence be, as they now generally are, attributed to the vapour of burning terrestrial metals in the solar photosphere, but that our metals should rather be supposed to be composed of these elements in different proportions." Spectroscopists will hardly consider the evidence he adduces in support of this hypothesis to be satisfactory, for it rests on no better foundation than the fact that when small fragments of zinc, lead, silver, aluminium and other metals are heated before the blowpipe flame in a bead of phosphoric acid each metal with the exception of tin, gold, platinum, and mercury is decomposed into a brick-red oxide, a brownish black gelatinous mass, and bubbles of some gas which smells like phosphuretted hydrogen.

An interesting and careful history of the use of the blowpipe is then given, at the conclusion of which the author alludes to his own labours, and after a careful examination of the work, we are convinced that we shall best do him justice by stating the principal observations that he claims as his own. These are—a method of detecting soda by means of the orange colour which is imparted to the "pure pyrochrome of boric acid." Potash, on the other hand, being detected by the blue colour produced by breathing on a bead of boric acid which has been blown into a thin vesicle, and in which the mineral has been fused. The separation and detection of "lime and the alkaline earths" by fusion in a bead of boric acid, when the oxides congest into small balls which float in the clear bead. The use of phosphoric acid as a solvent for certain metals, such as platinum and gold, and the adoption of sheet aluminium as a support, which, among other advantages, facilitates the roasting of arsenides and sulphides. In addition to these there are between thirty and forty other "novelties" which space will not permit us to enumerate.

The nomenclature employed in the work is rather bewildering; for instance, a flame having a conical shape is termed "a pyrocone;" a non-luminous flame tinged with colour "a pyrochrome;" and the crystallisation of substances from a state of fusion, is called "crystallignation." It will be evident that such terms become almost irritating when combined into words like "Ellychnine Pyrocone," which means a candle flame tinged with colour.

The tables for blowpipe analysis constitute a "Pyro-qualitative Indicating Chart," which Major Ross has divided into fourteen columns. Taking nickel, to which he specially directs attention as showing the merits of the table, we find that its reactions are described under three heads. First, with phosphoric acid an amber brown bead or, with little of the substance, an orange bead is produced. Second, with boric acid a bead containing green fragments is obtained in the O.P. (oxyhydrogen pyrocone), and metallic fragments in the H.P. (hydrocarbonous pyrocone), and third, when the substance is heated on an aluminium fusing tray in a "charcoal mortar" before the O.P. a green hairy mass is produced. Anyone familiar with blowpipe work will be able at once to compare mentally these directions with Plattner's concise and well-known tables which, by the by, are printed in the appendix. In addition to the well known reagents he employs many of unknown or uncertain composition, such as potassic tungstic borate, mangani cobalt solution, and thus complicates effects. We may give the following as an example of the author's chemistry:—"Sulphides are instantly detected upon it (aluminium foil) by fusing them with a small fragment of soda, and saturating the hot mass with a drop or two of water, when an inky black,

disgusting smelling precipitate of sodium sulphide is produced." It will be new to chemists that *sodium sulphide* is a black substance insoluble in water. There are a few well executed coloured lithographs, but the woodcuts, of which there are about forty, are very rough.

So much care and labour have evidently been bestowed on the preparation of the book, that we regret to be compelled to speak of it in terms of but faint praise. It is the work of an earnest enthusiast who has discovered some pretty reactions which might have at once become generally useful, had they been set forth in a clear and concise form.

THE ROCKS AND MINERALS IN THE MELBOURNE MUSEUM

A Descriptive Catalogue of the Specimens in the Industrial and Technological Museum, Melbourne. By G. H. F. Ulrich, M.E., F.G.S. (Melbourne, 1875.)

THE value of the collection of rock-specimens and minerals in the Museum at Melbourne will be much enhanced by the publication of this descriptive catalogue, which has been drawn up by Mr. Ulrich somewhat upon the model of the catalogue illustrating the collections in the Museum of Practical Geology in London. We learn from Mr. Newberry's preface that it originally formed part of the Report of the Museum presented to Parliament in 1874, and it is now reprinted with a view of making it more generally useful. Judging from the catalogue itself, we should say that the collection of rocks and minerals from the province of Victoria must be of an exhaustive character; the varieties are abundant, and embrace rocks of nearly every known description.

In drawing up this catalogue, the author has not neglected the geological conditions under which the specimens have been originally found; and along with the several varieties of granitic, plutonic, volcanic and sedimentary rock-specimens are also described the distribution and characteristics of the masses from which the specimens have been collected, together with their economic uses. In this part of his work the author has availed himself of the maps and reports of Mr. Selwyn, late Director of the Geological Survey of Victoria—whose important and successful operations in the field were brought to a close about seven years ago, by a sudden fit of parsimoniousness on the part of the Colonial Legislature. In describing the rocks, Mr. Ulrich has adopted the system of classification laid down by Zirkel in his *Petrographie* modified by the views of Von Cotta and other petrologists. But, however valuable such a classification may be when it is in the power of the observer to have constant recurrence to the aid of chemical analysis, we consider that for the field petrologist it is only occasionally available. The nice distinctions between the several species of plagioclastic felspars are only to be determined by laboratory analysis, and for the ordinary observer a classification founded on the presence or absence of quartz amongst the felspathic rocks; and on the determination of hornblende, as against augite as the basis of the pyrosenic rocks is sufficient. Daily experience, aided by microscopic examination, tends to show that definite species amongst rocks are but limited in number, and have little connection with geological age. On this ground we object to such terms as "diabase," with its several varieties mentioned in the *Table of Mixed Felspar Rocks*, as well as "anamesite," "felspar basalt," &c., though resting on the high authority of Dr. F. Zirkel; such being simply varieties of basalt or dolerite.

Again (in p. 24), several specimens are described under the head of "porphyrite," with its varieties, in all of which quartz-grains are present. Now, if this term means anything different from "porphyry," it means a *quartzless* porphyry, as its author, Naumann, proposed. Zirkel's definition is "quartzfreier orthoklas Porphyr." The presence of free silica, therefore, renders the name inapplicable; and although the matter is of little consequence, we refer to it to show the confusion which has arisen by the introduction into petrology of an objectionable name, and its use in a different sense from that intended by the original proposer.

Those portions of the catalogue relating to the occurrence of gold will be found of much interest, and must prove useful to colonists and adventurers in search of the precious metal. The upper Silurian strata rest discordantly on the lower—as in the British Isles—and in these latter are very numerous "veins, lodes, or reefs of quartz," which traverse the beds, varying from one inch to above 100 feet in breadth. According to Mr. R. Brough Smyth's statistics for 1874, the number of these actually proved to be gold-bearing amounted to 3,367, which was being constantly added to owing to the energy of the mining population. These reefs are the original source of the gold, which is extracted directly from the quartz, but more frequently from the detrital strata derived from the denudation of the Silurian rocks, and now arranged in three divisions of "Drift," of which the oldest is the most auriferous. Associated with the gold grains are minerals and precious stones in such variety and profusion as is only granted to a few favoured spots, amongst which we notice the diamond, ruby, sapphire, topaz, zircon, garnet, amethyst, Cairngorm, opal, &c., besides metallic ores, all jostling each other amidst the stones, clay, and sand which would conceal their charms from the unpractised eye.

On the whole, the volume before us affords a remarkable illustration of the similarity of the materials which enter into the composition of the earth's crust all over the world, or at least in widely separated districts. Here at the Antipodes we have a series of rock-specimens exemplifying the rock-formations of Victoria, nearly every one of which finds its representative in the British Islands. We find similar granites, felstones, porphyries, diorites, mica-traps, dolerites, basalts, schists, serpentines and quartzites, sandstones, slates and limestones, and even the rare "nepheline-basalt" of Philip Island and Port Ray has its representative in the Wolf Rock, off the coast of Cornwall, as Mr. Allport has recently determined. As regards the drawing up of the catalogue, the most scrupulous care has evidently been exercised, both in determining the nature of the specimens themselves, and in identifying their localities; while a very good idea of the geological structure of the colony may be obtained from a perusal of its pages.

OUR BOOK SHELF

A Monograph of the Trogonidæ; or, Family of Trogons. By John Gould, F.R.S., &c. (London: Published by the Author, 1875.)

THE completion of a second edition of Mr. Gould's "Monograph of the Trogons," is an event which ought not to pass by without a notice in this Journal. The first edition of this work, published in 1838, was one of the earliest of Mr. Gould's magnificent series. Of its fellow Monograph, that of the Toucans, a second edition was issued some time since, and the present work is a worthy companion to it. During the thirty-seven years which have elapsed since the publication of the first edition of the "Monograph of Trogons," Mr. Gould, as his brother ornithologists know full well, has by no means neglected the subject, but has from time to time brought forward descriptions of new species that have come to his knowledge from the more thorough exploration of the tropics that has of late years taken place. From these, and other sources, the number of known Trogons, which at the time of the first Monograph was thirty-four only, has now been increased to forty-six, of the whole of which splendid life-sized pictures, according to Mr. Gould's wonted practice, are given in the present volume.

Like the Parrots, the Trogons are widely diffused through the tropics of both hemispheres. Though not so strongly marked in general characters as the Psittacidæ the Trogonidæ are separated from all other known birds by the peculiar conformation of their feet, having the first and second toes permanently turned backwards, which is not the case in any other form of the class "Aves." Like the Parrots, too, the Trogons are most numerous in the New World, thirty-three out of the forty-six species being peculiar to Central and Southern America, whilst eleven are found in the Indian region, and two only in Africa. As regards habits and mode of life, there appears to be much similarity in the Trogons of all three continents. They are universally forest-haunting birds, inactive in habits, short in flight and feeding, whether their prey be insect or fruit, mostly upon the wing. Their brilliant colours offer the most remarkable compounds of emerald green and various shades of crimson and golden yellow, as will be sufficiently apparent to anyone who turns over Mr. Gould's splendidly-coloured plates. We must indeed congratulate the author on the energy and success with which, prompted by the pure love of science, he has brought out a second edition of one of the first of his many important ornithological works.

Geologie der Kohlenlager, von Dr. Hermann Mietzsch, Geolog der Landesuntersuchung im Königreiche Sachsen. (Leipzig, 1875).

FOR those to whom the magnificent work of Geinitz, Fleck, and Hartig, *Die Steinkohlen Deutschlands*, is inaccessible, the smaller treatise before us will prove acceptable. From the practical acquaintance of his subject gained in his professional duties, Dr. H. Mietzsch was well fitted to produce a treatise on the physical properties of coal and the phenomena connected with its place amongst the strata; while, with the industry which generally characterises German authors, he has made himself acquainted with what has been written on the subject by French and English writers, as well as those of his own fatherland, and has woven the whole into a connected account of the history of coal-mining, the properties of coal, and the conditions under which it has been found in various countries and periods, as well as the structure and mode of formation of coal-fields and coal-basins. The work is illustrated by twenty-five woodcuts, and appears to bring the subject well up to the present state of our knowledge. E. H.

LETTERS TO THE EDITOR

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

Evidences of Ancient Glaciers in Central France

WERE this a question concerning volcanic phenomena, with which Mr. Scrope is as familiar as I am with glacial ones, I might be disposed to defer to his opinion. As it is, having only his assertion that I have mistaken the results of a recent landslip (*i.e.* a spot where there are no traces of landslip, and to which no landslip could have reached) for time-worn and weathered glacier-transported blocks, I ask the readers of NATURE to pause before disposing of my powers of observation as summarily as Mr. Scrope does; remembering that the history of all glacial phenomena, from scratched boulders to lake-basins, has been successively overlooked, denied, and misinterpreted, before being understood and accepted.

The landslip to which Mr. Scrope refers, and which he describes as having occurred in 1859, under cliffs nearly a thousand feet high "on the left flank of the valley looking upwards," is in a very different position from that of the blocks to which I have directed attention. There are no cliffs whatever such as Mr. Scrope describes on the left flank of the valley anywhere near their position, nor for half a mile above it. The left flank of the valley for half a mile above them forms a very gentle slope indeed, and rises but a very few hundred feet above its floor, without cliff or rock protruding on its surface.

On the other hand, the evidences of old ice action in the Mont Dore district, and elsewhere in Central France, are as conclusive as in Western Scotland, M. l'Abbé Lecoq notwithstanding, for whose labour in his own line of research I have as high a regard as I have for Mr. Scrope's.

J. D. HOOKER

Sir Thomas Millington and the Sexuality of Plants

The letter of your anonymous correspondent "A. B. C.," in your issue for Dec. 16, hardly seems to need a reply, inasmuch as he has added nothing whatever to the solution of the question raised in mine, whether any writings of Sir Thomas Millington are in existence which confirm the alleged discovery by him of the sexuality of plants. From the silence of your correspondent on this point, as well as of the two writers referred to in my letter, I infer that no such writings are, at all events, readily accessible. There are, however, some statements by your correspondent which cannot be allowed to pass uncorrected.

First, as to the bibliographical matter: "A. B. C." says "there is no such thing" as a second edition of Grew's book—a somewhat rash assertion in the face of the fact that the words "The 2nd edition" are printed on the title-pages of three out of the four books which make up "The Anatomy of Plants," first published as a whole in 1682. The facts of the case are these: In 1672 Grew published a small volume under the title "The Anatomy of Vegetables begun, with a general Account of Vegetation founded thereon;" in 1682, a much larger work entitled "The Anatomy of Plants begun, with a general Account of Vegetation founded thereupon," a portion of which is a reprint of the earlier work. I fail to see why I should be held up to reproach as having almost committed a literary crime in referring to the larger as "a second edition" of the smaller work.

Now as to the more important matter. Without bringing forward a tittle of fresh evidence, "A. B. C." makes the confident assertion that it is "also clear enough" that Millington is entitled to be described as the discoverer of the sexuality of plants. In singular juxtaposition with this assertion he quotes a paragraph from Sprengel in which some half-dozen illustrious botanists are named in this connection, but Millington is not even mentioned! The preceding quotation from Grew is made to appear as if it owed its inspiration to Millington; whereas, after the graceful reference to his friend the Savilian Professor, Grew commences his account with these words:—"The sum therefore of my thoughts concerning this matter is as follows." It would seem as if, at the close of the seventeenth century, fresh insight into the phenomena of fertilisation was being gained by a number of botanists in both England and Germany; but "A. B. C." has established no right to express an opinion in so *ex cathedrâ* a style in favour of Millington's sole claim to the discovery. For evidence

that the observations of Kamerer of Nürnberg (Camerarius) anticipated by two years the publication of Ray's "Historia Plantarum," I must refer him and any of your readers who are interested in the subject to Sachs's "Geschichte der Botanik."

Linnæus ("Amœnitates," vol. i. pp. 329, 330) thus sums up the relative merits of Millington, Grew, Ray, and Camerarius: "Thomas Millington, eques Anglus, Professor Savilianus, primus videtur, qui insigni cura in hanc veritatem eruendam incubuit, viamque aperuit experientissimo Grewio. Nehemias Grew, in anatome Plantarum, sexus diversitatem et fecundationem plantarum per farinam mascule scrutari conatus est; cujus *hypothesibus*, album addidit calculum temporis sui botanicus eximius Rajus. Rudolphus Jacobus Camerarius primus perspicue *demonstravit* sexum et generationem, quamvis non dubii fuit ipse expers de hac veritate, quod si moverant experimenta quæ fecerat in Cannabe."

Now as to Theophrastus. Your correspondent makes much of the "prolifick virtue" ascribed to the pollen-grains by Grew. No one, however, can have read the writings of the early Greek and Roman naturalists without having learned, that not only did they distinguish male and female flowers, but also ascribed a "prolific virtue" to the pollen. Without troubling your readers with a Greek quotation, let us hear what a commentator on Theophrastus says:—"Theophrastus ait, fructum in palma feminæ perdurare nunquam posse nisi florem maris cum pulvere super eam concusserint;" and again: "In palma maris et fœminæ coitus sit;" or again, Pliny: "Adeoque est veneris intellectus, ut coitus etiam excogitatus sit ab homine ex maribus, flore, et lanugine, interim vero tantum pulvere insperso feminis."

I hardly think your readers generally will agree with "A. B. C." in his opinion that "time, paper, and ink are wasted" in a discussion of a historical point of some interest.

Dec. 24 ALFRED W. BENNETT

Saw-fish Inhabiting Fresh Water

IN NATURE, vol. xiii. p. 107, Mr. Wood, of Manila, writes on "Saw-fish inhabiting fresh water," in the Laguna de Baij, Luzon, as on something curious and new. But this fact was known long ago; not only do sharks live in fresh water there, but also elsewhere on the globe. As one who mentions the saw-fish in the Laguna de Baij, I only name the famous de la Gironnière ("Aventures d'un Gentilhomme Breton," 1857). He says, p. 102: "Deux poissons de mer se sont acclimatés dans les eaux douces du lac: le *reguin* et la *scie*. Le premier est heureusement assez rare, mais le second est très abondant."

The species of saw-fish mentioned is *Pristis perrotetti*, a species of very wide distribution; it has been collected in the Atlantic (West Indies), in the Indian Ocean (Zambesi), in the China Sea (Borneo), &c.

When on Luzon in the year 1872, I succeeded in procuring a series of specimens on the spot, which I brought home; they are from two to three feet long, but I saw, myself, at the fish-market of St. Cruz a specimen of about twenty feet in length. Quantities are to be seen on every market day in St. Cruz, the flesh being very cheap on account of its bad and dry quality, and only the poor mountaineers like it as food.

I took some trouble to get those smaller specimens home, because I fancied that they might possibly differ from the marine specimens (Bay of Manila). But an accurate comparison showed no difference at all, and therefore the changed conditions seem to have had no influence on the external features of the species.

The saw-fishes are said to fight violently with the crocodiles, which occur in large quantities in the Laguna, and I do not doubt the fact. A. B. MEYER

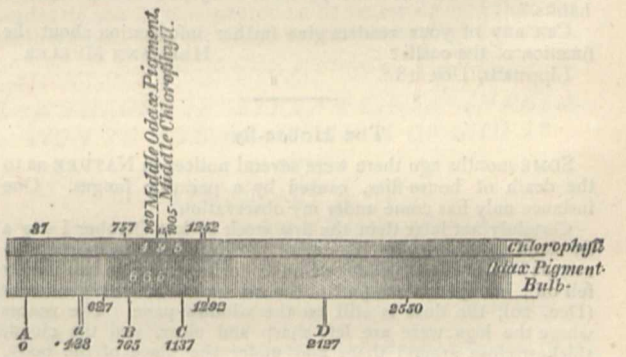
Dresden, Dec. 23

Spectrum of Fish-pigment

I HAVE lately observed the spectrum of a pigment-colour found under the scales in fins and tail, mouth and eyes, of a small smelt-like fish found in St. Vincent's Gulf, S.A. They are commonly known as the Weed fish, but Mr. Waterhouse, our Curator, informs me they are the *Odax radiatus*, *O. frenatus*, *O. Richardsonii*. These fish are perfect little gems for colour, being of a bright blue green (nearly blue) in *O. Richardsonii*, and about the eye most splendid; black centre, brilliant orange ring, outside of which is a most brilliant turquoise blue ring set in deep brown.

Finding this colouring matter stained paper, I examined the scales and fins by spectroscope, and noticed a deep band that appeared to correspond with the deep band of chlorophyll. I send a sketch of the respective spectra and a bulb and tube of the pigment in solution, which, with the pieces of tail and fins, I trust you will receive in good condition. I do not place much faith in it remaining clear and brilliant; the heat of the ship may possibly destroy or alter it. You will notice the solution is rather bluer than chlorophyll. This pigment is nitrogenous, is destroyed by heat, chlorine, acetic acid, alkalis, ammonia, and alcohol. It is soluble in water and sea-water. Sulphuric acid precipitates it with albumen of fish, but does not destroy colour. Light bleaches it. Its chemical properties are therefore distinct from those of chlorophyll.

I consider some interest attaches to this from the fact of the Parrot-fish (*Labrichthis Richardsonii*) being marked with blue stripes containing the same colouring matter; also the scales and parts in Odax coloured orange give a green tint almost identical in shade to chlorophyll. This yellow or orange does not give



Spectra with kerosine flame on edge of Odax pigment and comparison with chlorophyll.

Dividing the Solar spectrum into 10,000 parts from A. bright kerosine flame on edge gives as above. The chlorophyll band is rather lighter in the centre; when solution is dilute it divides into two fine lines. Width of strong band, 495.

The Odax Pigment does not resolve into two lines. The centres of these two great bands Odax Chlorophyll are only forty-five apart. Width of band, 665; rather nebulous, especialy at end of greatest refraction. Some very faint bands occur each side of D, and continue to end of nebulosity to 2,550. The bulb gives the above figure. The tube a much narrower band, but centre coincides with bulb.

any band or interfere with the spectrum of the pigment, except so far as its mere colour and general absorption at blue end arising from such colour.

Now as chlorophyll has been said to be found in some infusoriæ, which I doubt, it is just possible that this or similar colouring matter is taken for it. I have been rather curious in examining animal greens in shells, and a native green silk we have here, also in the Emu egg-shell, but cannot find the slightest trace of chlorophyll band, and until I met with this I concluded no animal green yielded any band that could be mistaken for chlorophyll, and that therefore the spectroscope was an unerring test for distinguishing between vegetable and animal organisms. This spectrum of Odax pigment, which possibly I may find in other species of fish, Actiniadæ or Medusæ, many of which are beautifully coloured, is therefore so far of interest. I trust these remarks may be interesting and lead to some inquiry in this direction.

The dry pieces of fins and tail, also a piece of stained paper, will show well if mounted in balsam. If the colour is not deep enough, cross the layers one over the other until sufficient depth of shade is obtained. I use half-inch object glass in microscope except for scales and spots, when I use quarter, and shut out all other light; single scales then show the bands well.

GEORGE FRANCIS

Laboratory Institute, Adelaide, Oct. 9

Function of the Ocelli of Hymenopterous Insects

MY brother, Fritz Müller (Itajahy, Prov. St. Catharine, South Brazil), in his letters to me, has repeatedly started the question whether the size of the ocelli of hymenopterous insects is not dependent on their nocturnal habits. He supports this opinion by the following observations:—

1. *Apoica pallida*, one of the social wasps of Brazil, in the daytime rests quietly in its nest, which resembles the nest of our *Polistes gallica*, but is attached to the twig of a tree. During the evening it looks after flowers, and, whether sitting on them, and sucking their honey, or flying about in the moon-light, by its moonlike colour it is protected from its enemies. It differs from the allied species, which have diurnal habits, in the largeness of its ocelli.

2. One of the solitary Apidæ of Itajahy, belonging to the family of Andrenidæ (*Eophila matutina*, F. and H. Müller) has the singular habit of visiting flowers exclusively in the twilight of earliest morning, and is also provided with unusually large ocelli.

3. A species of *Dorylidæ*, probably belonging to the genus *Labidus*, found, Oct. 1875, by my brother's daughter Anna, late in the evening, flying towards the candle-light, is likewise remarkable for strikingly large ocelli. Concerning *Dorylus*, Gerstaecker says: Ocelli large, bladdered ("Ocellen gross, blasig"); and Westwood (Introduct. vol. ii., p. 216), "Mr. Burchell has informed me that the African species of Dorylus is nocturnal in its habits."

Can any of your readers give further information about the function of the ocelli? HERMANN MÜLLER

Lippstadt, Dec. 18

The House-fly

SOME months ago there were several notices in NATURE as to the death of house-flies, caused by a parasitic fungus. One instance only has come under my observation.

Certainly not later than the first week of last October I saw a fly standing dead on the outside of the pane of my window, surrounded with a small cloud of dust. After a day or two the fly fell off; but the curious part of the matter is that at this moment (Dec. 20), the dust is still on the window-pane. The spaces where the legs were are left sharp and clear, and the cloud, thickest close around them and under the place of the body, thins out gradually round to the distance of above an inch. Looked at through the window-glass (I cannot get at the outside), a pocket-lens resolves it into nothing more than coarser dust, presenting much the appearance of iron filings round the pole of a magnet, in the manner it diverges from the centre. Can any microscopist inform me, through NATURE, whether the fungus actually takes root on the glass, or by what means it has been able to maintain its adherence through the many drenchings of rain and snow to which the window has been exposed during this stormy season? M. E.

Mountfield, Sussex, Dec. 20

The true Nature of Lichens

The writer of the criticism on "Haeckel's History of Creation," in NATURE, vol. xiii. p. 121, will confer a favour on British Lichenologists if he will explain what he means by asserting that "the true nature of Lichens has been cleared up" of late years. W. LAUDER LINDSAY

[The reviewer referred to the investigations of Prof. Schwendener, of Basel: "Untersuchungen über den Flechtenthallus" (Nägeli's *Beiträge zur wiss. Botanik*, 1868), and "Eröterungen zur Gonidienfrage" (*Flora*, May, 1872). A translation of the latter paper appeared in the *Quarterly Journal of Microscopical Science* (vol. xiii. p. 235). See also "A *resumé* of recent views respecting the Nature of Lichens," by Mr. Archer (*ibid*, 1873, p. 217), and "Sexual Reproduction of Thallophytes," by Prof. Thiselton Dyer, in the same journal for last July, p. 296.—ED.]

The Boomerang

TRUSTWORTHY information respecting the performance of the boomerang is a *desideratum*. Reports from professed eye-witnesses as to its behaviour are frequently highly sensational and perplexing. It has been seen, so it is said, to strike an object with great violence and then to return to the hand of the projector! That its rapid rotation round the shortest axis passing through its centre of gravity should, as in the gyroscope, tend to make it keep its original plane of rotation, is clear. That its progressive force being expended before its rotatory force, it should tend to fall in the direction of the least resistance, *i.e.* to return on its path, need not be doubted. But striking an object with violence must, one would suppose, change its plane of rotation; and then there would be no disposition to return on its path. In the notice in last week's NATURE of "Artes Africanæ" it is stated that the African boomerang is thrown so as to rotate in a horizontal plane; in which case, except by accident, there would be no tendency to return to the thrower, a mode of action supposed to be proper to the boomerang. Many know the toy boomerang made of card-board, "V" shaped, with one limb shorter than the other, say four and two and-a-half inches respectively. When this toy is laid on the smooth cover of a book held at an inclination of about 60°, and when the shorter limb projecting just beyond the edge of the book is struck with a smart fillip of the finger so as to project it rotating rapidly at an upward angle of 60°, the toy will reach the further side of a room and return; but of course if it strikes anything its plane of rotation is changed and it falls irregularly. HENRY H. HIGGINS

OUR ASTRONOMICAL COLUMN

SMALL STAR WITH GREAT PROPER MOTION.—In vol. v. of the Madras Observations, Taylor mentions having observed in 1838 or 1839 a star of the 9th magnitude near to Brisbane 3458 (which appears not to have been found), the position of which, by three observations, is thus given for 1840:—R.A. 11h. 5m. 25·71s, N.P.D. 118° 59′ 12″·62.

Argelander twice observed a star of the same magnitude (Oeltzen, Nos. 11237-8) in zones 374 and 377, 1851 April 22 and 28, the mean place of which for 1850 is in R.A. 11h. 5m. 50·98s, N.P.D. 119° 1′ 52″·95. Assuming the identity of the stars observed by Taylor and Argelander, of which there can be little doubt, the comparison of positions for 1840 and 1850, taking the date of opposition of the star in 1838 as about the epoch of Taylor's observations, unfortunately not stated, shows an annual proper motion of − 0·293s in R.A., and of − 2″·74 in N.P.D., or 4″·72 in arc of great circle in the direction 305°·5. If this amount of proper motion is confirmed, it will be fourth in order of magnitude of the great proper motions of stars yet satisfactorily ascertained, and the list will then stand as follows:—

	Proper Motion in Arc of great Circle.	Direction of Motion.	Magnitude.
	′	°	
Groombridge 1830...	7·05	145·0	7
61 Cygni ...	5·21	51·8	5½
Lalande 21185 ...	4·75	186·6	7
Taylor's star ...	4·73	305·5	9
ϵ Indi ...	4·63	124·8	5½
Lalande 21258 ...	4·40	282·4	8½
40 Eridani ...	4·09	212·0	4½
μ Cassiopeæ ...	3·83	115·3	5½
α Centauri ...	3·81	276·6	1

Lalande 21185, is "Argelander's second star" of Prof. Winnecke, and No. 21258 is the star called "Argelander's third" by Dr. Krüger.

If Taylor's observations of the star of ninth magnitude were made in 1839, it should be third on the above list, but the precise amount of proper motion must remain for comparison of Argelander's position obtained in 1851, with future observations, it may be hoped early in the next year.

The N.P.D. of Brisbane 3458 mentioned above, agrees exactly with that of Lacaille 4641, but the R.A. differs 1m. 8s.; the magnitudes are the same.

THE SECOND COMET OF 1702.—The first comet of this year does not figure in our catalogues of cometary orbits, no observations properly so-called having been obtained. In Europe the tail only was seen by Maraldi and Bianchini at the end of February and beginning of March. The second comet of 1702 was observed at Berlin, Paris, and Rome, in the last ten days of April and beginning of May, and orbits have been calculated by Lacaille and Burckhardt; the latter reduced the observations anew, but it does not appear what data he had besides those

published in the "Memoirs of the Paris Academy." It is singular that the original observations of this comet, given in "Francisci Blanchini Veronensis Astronomicæ ac Geographicæ Observationes selectæ" (Verona, 1737) have not, so far as we can discover, been fully calculated. The volume is not mentioned amongst those consulted by Pingré, in the preparation of his great work, the "Cométographie," and is probably rare. A preliminary reduction of these observations exhibits considerable difference from Burckhardt's parabola, and in presence of the suspicious indications of ellipticity, small inclination and direct motion, it may result that Bianchini's observations may be sufficient to add another comet of short period to those already known—at least so far as to render probable its having moved in an elliptical orbit of small extent, at the time it was observed, which is about all that can be said in the case of the comet of 1766, or of the first comet of 1743. It is certain that it must have been very near to the earth shortly before Bianchini discovered the comet on April 20. In a short time we may have more to say respecting the movements of this body.

THE TOTAL SOLAR ECLIPSE of 1999, AUGUST 11.—In NATURE, vol. xii. p. 213, were given the elements of the eclipse of 1927, June 28, which will be total in the north of England, though only for nine or ten seconds even on the central line; it is the first total eclipse that will be visible in these islands during the ensuing century, and there is only one other eclipse that can be witnessed in its totality in England before the year 2000. It is that of 1999, August 11, of which we proceed to give some account.

The elements of the eclipse are as follows:—

Conjunction in R.A. 1999, Aug. 10, at 22h. 50m. 8s. G.M.T.			
R.A.	140°	46′	31″
Moon's hourly motion in R.A.		35	29
Sun's ,, ,, ,, ...		2	22
Moon's declination	15	50	11 N.
Sun's ,, ...	15	19	49 N.
Moon's hourly motion in decl.		7	44 S.
Sun's ,, ,, ,, ...		0	44 S.
Moon's horizontal parallax		58	43
Sun's ,, ,, ...			9
Moon's true semi-diameter		16	0
Sun's ,, ,, ...		15	47

The sidereal time at Greenwich mean noon on Aug. 11 is 9h. 18m. 2·0s., and the equation of time 5m. 16s. subtractive from mean time.

The central eclipse begins 21h. 29·4m. in long. 64° 49′ W., lat. 41° 11′ N.; central with sun on meridian in long. 18° 47′ E., lat. 46° 47′ N.; central eclipse ends oh. 34·8m. in long. 87° 33′ E., lat. 17° 31′ N.

So far as regards this country the most favourable locality for observation will be in the vicinity of St. Ives, in Cornwall, which place is almost exactly on the line of central eclipse. Taking the position of St. Ives in long. 5° 26′ W., lat. 50° 12′ we find—

	h.	m.	s.	
Beginning of totality August 11 at	9	47	42	A.M. local time.
Ending ,, ,, ,,	9	49	42	,, ,,

The duration of total eclipse is therefore 2·m.

The sun's apparent altitude at this time is 47°.

If we found equations of reduction upon this direct calculation for St. Ives, we shall have the following expressions by means of which anyone who is curious in the matter may examine the durations for such places as fall within the total eclipse:—

$$\text{Cos. } w = 70{\cdot}8267 - [2{\cdot}12739] \sin. l + [1{\cdot}70001] \cos. l, \cos. (L + 11^{\circ}\,55'{\cdot}6)$$
$$t = 23\text{h. } 19\text{m. } 48\text{s.} \mp [1{\cdot}78051] \sin. w - [3{\cdot}27551] \sin. l + [3{\cdot}92586] \cos. l, \cos. (L - 114^{\circ}\,40'{\cdot}1).$$

In these formulæ l is the geocentric latitude, L the longitude from Greenwich taken *negative*, and t the Greenwich mean time of beginning or ending, according as the upper or lower sign is employed; the quantities within the square brackets are logarithms.

For that portion of the zone of totality falling upon English ground we have—

Long. W.	Lat. North Limit.	Central Eclipse.	South Limit.
2° 30′ ...	50° 35′·9 ...	50° 8′·2 ...	49° 40′·5
3 30 ...	50 38·2 ...	50 10·5 ...	49 42·8
4 30 ...	50 40·4 ...	50 12·6 ...	49 45·0
5 30 ...	50 42·2 ...	50 14·5 ...	49 46·9

These results may be expected to prove pretty near the true ones, being derived from elements of the lunar motions which represent with considerable precision the circumstance of the total eclipse in England in 1715, and the annular eclipse of 1737, which was well observed at Edinburgh by Lord Aberdour and Maclaurin.

THE ZODIACAL LIGHT.—This phenomenon presented itself rather conspicuously in the neighbourhood of London on the evening of the 23rd inst., though the vaporous condition of atmosphere seriously interfered with any attempt to trace its outlines satisfactorily. The southern border of the light appeared to be better defined than the northern one, and the latter seemed to be slightly curved.

THE THEORY OF "STREAM LINES" IN RELATION TO THE RESISTANCE OF SHIPS *

IV.

SUPPLEMENTARY NOTES.—A.

THE proposition, that the flow of fluid through a tortuous pipe when its ends are in the same straight line, does not tend to push the pipe endways, can be treated in several ways, of which only one is given in the text of the address; but it may be interesting to some readers to trace some of the other ways of viewing the question.

First let us take the case of a right-angled bend in a pipe (that is to say where the direction of a pipe is altered through a right-angle by a curve of greater or less radius; a bend of this sort is shown in Fig. 29), and assume that the fluid in it at A is flowing

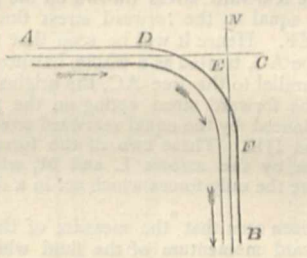


FIG. 29.

from A towards C. I propose at present to deal only with those forces or tendencies which act more or less powerfully in the direction of the original motion of the fluid, namely along the line AC.

I must here remind you that I am dealing with this matter entirely independently of hydrostatic pressure. Perhaps to some it will be difficult to dissociate the idea of hydrostatic pressure from a fluid in a pipe. This difficulty might be got over by assuming that the pipe is immersed in a fluid of the same density and head as the fluid within it. There will thus be hydrostatic equilibrium between the fluid within and without the pipe, the only difference being that the fluid inside the pipe is assumed to be in rapid motion, and thus to subject the pipe independently to any stresses properly incidental to that motion of the fluid within it.

The sole work that has to be done in the present case, is that of deflecting the current of fluid to a course at right angles to its original course AC; and, regarding these forces as resolvable throughout into two sets of components, the one at right angles to the line AC, the other parallel to it, it is of the latter alone that account is to be taken. Manifestly the sum of these components is measured by the circumstance that it is precisely sufficient to entirely destroy the forward momentum of the fluid that flows

* Address to the Mechanical Section of the British Association, Bristol, August 25, 1875; by William Froude, C.E., M.A., F.R.S., President of the Section. Revised and extended by the author. Continued from p. 133.

along the pipe at A towards the bend. This force is administered to the fluid by the curved portion of the pipe at the bend DEF; and as the pipe is assumed to be rigid, the work of arresting the forward velocity of the fluid throws a forward stress on the pipe in a direction parallel to the line AC.

Let us now assume that to the right-angled bend AB we attach rigidly a second right-angled bend, BG, as shown in Fig. 30, in such a manner that the termination of this second bend

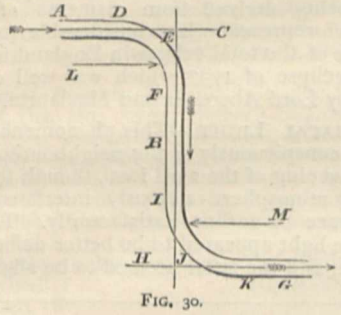


FIG. 30.

at G is parallel to the commencement of the first bend at A. Here I will again, for the present, deal only with the forces in a direction parallel to the line AC.

The fluid at B has no velocity in the direction of the line AC, and at G it has a velocity in that direction equal to the velocity which it had at A. To give it this velocity in a forward direction (I mean forward in its original direction of motion), to establish this forward momentum, requires the application of a force in the direction HG; and this force is administered to the fluid by the curved portion of the pipe at the bend IJK; and as the pipe is assumed to be rigid, the duty of establishing the forward velocity of the fluid throws a rearward stress on the pipe in the direction GH. Now as the forward momentum given to the fluid between B and G in the line GH is exactly the same as the momentum destroyed between A and B in the line AC, it follows that the rearward stress thrown on the pipe at the bend IJK is exactly equal to the forward stress thrown on the pipe at the bend DEF. Hence it will be seen that the forces acting on the rigid pipe AG, treated as a whole, balance, so far as relates to the forces parallel to the line AC, the original line of motion of the fluid—the forward stress acting on the pipe at the bend DEF being balanced by the equal rearward stress acting on the pipe at the bend IJK. These two of the forces acting on the pipe are shown by the arrows L and M, which, it must be remembered, are the only forces which act in a direction parallel to the line AC.

It will have been seen that the measure of these forces is the amount of forward momentum of the fluid which is destroyed or created; and from this it will be inferred that the forces will be the same, no matter what is the radius of the curve of the pipe, inasmuch as the curvature of the pipe does not affect the amount of the forward momentum that has to be destroyed or replaced in the fluid.

Let us next take the case of a bend in a pipe that is not a right angle, as shown in Fig. 31; and here, as before, I only

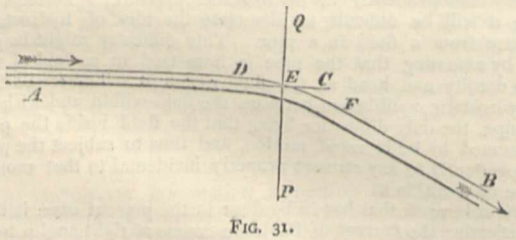


FIG. 31.

propose to deal with the forces that operate in a direction parallel to the line AC, that is, of the original motion of the fluid. Now in this case the forward motion of the fluid is not, as in the instance of the right-angled bend, entirely destroyed in its progress from A to A; only a portion of the forward motion is checked, and the same portion of the forward momentum destroyed; and the force by which it is destroyed is administered to the fluid by the curved portion of the pipe at the bend DEF, and, as in the former case, constitutes a forward stress on the pipe in the direction of the line AC, which will bear the same ratio to the stress which would follow from the destruction of the whole, as the portion destroyed bears to the whole forward momentum.

Suppose to this bend we attach rigidly another bend BG, of same angle, as shown in Fig. 32, so that the termination of this

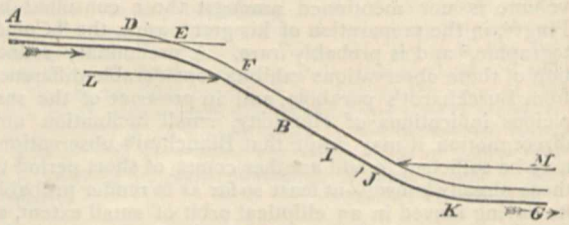


FIG. 32.

second bend at G is parallel to the commencement of the first bend at A. Here, in the portion of the pipe BG, that part of the forward velocity which was taken away has to be again given to the fluid; this requires force, which is administered to the fluid by the curved part IJK of the pipe. There is thus thrown on the pipe a rearward stress represented by M. The force required in the bend between B and G to reinstate completely the forward velocity, is evidently the same in amount as the force required in the bend between A and B to destroy in part the forward velocity.

It follows, therefore, that the two stresses on the pipe, represented by the arrows L and M, which indicate the forces acting on the pipe, are equal and opposite to one another, and these are the only forces acting on the rigid pipe in a direction parallel to the line AC or the original motion of the fluid at A. It follows, therefore, that in case of two right-angled bends rigidly connected, or in the case of two connected equal-angled bends of any other angle, the stresses brought on the pipe by the flow of the fluid will not tend to move the pipe bodily endways.

It will be seen also by this reasoning that the forces we have referred to do not depend on the curvature of the pipes, but are simply measured by the amount of the forward momentum of the fluid and the extent to which that momentum is modified by the total of the deflection which the course of the fluid experiences in passing the bend, or, in other words, by the angle of the bend. And from this reasoning it becomes apparent that by

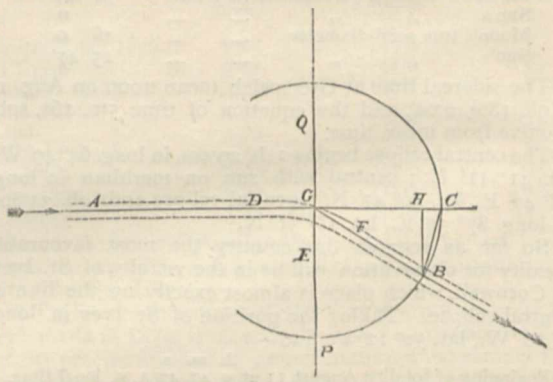


FIG. 33.

Let AGB = angle of bend.
Let GC = force required to destroy the whole momentum of fluid in line AC.
,, = tension which would be put on pipe AD by a right-angled bend.
Then HC = force required to destroy momentum lost at the bend in the line AC.
And HB = force required to establish momentum acquired at bend in line QP.
∴ BC = total force acting on pipe.
This force must be in equilibrium with the tensions of pipe along BG and AC.
∴ the tension of pipe = GC or GB.
i.e. = the tension of pipe when the bend is right angled.
Therefore the tension of the bent pipe is constant for a given velocity of flow, whatever be the angle of the bend.

whatever bends or combinations of bends we divert the course of a stream of fluid in a pipe, provided the combination be such as to restore the stream to its original direction, the aggregate of the forces in one direction required to destroy forward momen-

tum are necessarily balanced by equal forces in the opposite direction required to reinstate the former momentum.

It will be useful to consider more in detail the action of all the forces operating on a fluid in a bend of the pipe; and I will return to the case of a single right-angled bend, as shown in Fig. 29. I before spoke merely of the forces acting parallel to the line AC, and said that the forward momentum of the fluid in that line had to be destroyed in its passage round the bend DEF, and that this must be effected by a force acting parallel to AC, which would throw a forward stress on the pipe, tending to force it in the direction AC. But similarly velocity has to be given to the fluid in the direction NB; and to do this a force must be administered to the fluid which will cause a reaction on the pipe in the direction BN; and as the momentum to be established in the direction NB has to be equal to that in the direction AC, which had to be destroyed, it follows that the forces of reaction upon the pipe in the directions AC and BN are equal. These forces can be met in two ways, either by securing the bent part of the pipe DEF so that it will in each part resist the stresses that come on it, or by letting the forces be resisted by the tensional strength of the straight parts of the pipe AD and BF operating in the direction of their length; and in this case we see that the tension on AD must be equal to the force acting along AC, and the tension on BF must be equal to the force acting along BN, so that in fact the forces brought into play by the right-angled bend produce a longitudinal tension on the pipe at either end of the bend equal to the force required to destroy the forward momentum of the fluid.

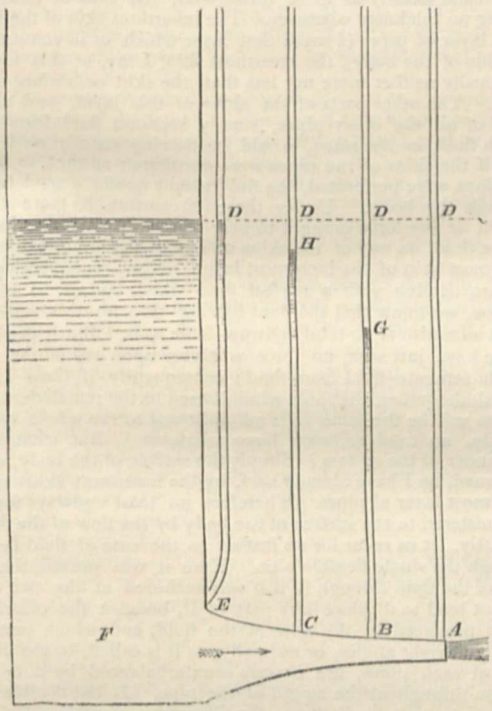


FIG. 34.

Proceeding to the case of the non-right-angled bend, as shown in Fig. 31: in this case, as we have seen, a portion only of the forward momentum of the fluid in the line AC has to be destroyed, also a certain amount of sideways momentum has to be created in a direction which we may consider parallel to the line QP; and the composition of the remaining forward momentum in the line AC with the created sideways momentum in the line QP, results in the progress of the fluid along the path FB; this partial destruction of forward momentum and establishment of some sideways momentum are essential to the onward progress of the fluid along FB. The bend DEF will be subject to the reaction of the forces necessary to produce these changes; and either the bend may be locally secured, or the stress upon it may be met, as in the case of the right-angled bend we have just been considering, by a tensional drag on the pipe at either end of the bend. There is, however, this difference between the cases, that the force required to establish sideways momentum parallel to QP cannot be directly met by the reaction of tension along the line BF of the second part of the pipe; but this force may be met by the obliquely acting tension of the pipe BF combined with the induced tension along the pipe AD. It is well known that in the case of a given force, such as that we are supposing parallel to PQ, resisted by two obliquely placed forces such as the tension along the lines DA and FB, the nearer the lines DA and FB are to one straight line, the greater must be the tension along those lines to balance a given force acting on the line PQ. Now the less the line FB diverges from the line AC, the less will be the sideways momentum parallel to QP that has to be imparted to the fluid; but at the same time and to precisely the same extent will the proportionate tension put upon the limbs DA and FB of the pipe be aggravated by the greater obliquity of their action. The sideways pull is greatest when the bend is a right angle; and then it amounts to a force that will take up or give out the entire momentum of the fluid, and it is supplied directly by the tension of the limb of the pipe at FB. If the bend is made less than a right angle, the less the bend is made, the less is the sideways pull, but the greater by the same degree is the disadvantage of the angle at which the tension on the pipe resists the pull; and it results from this that in the case of a bend other than a right angle,

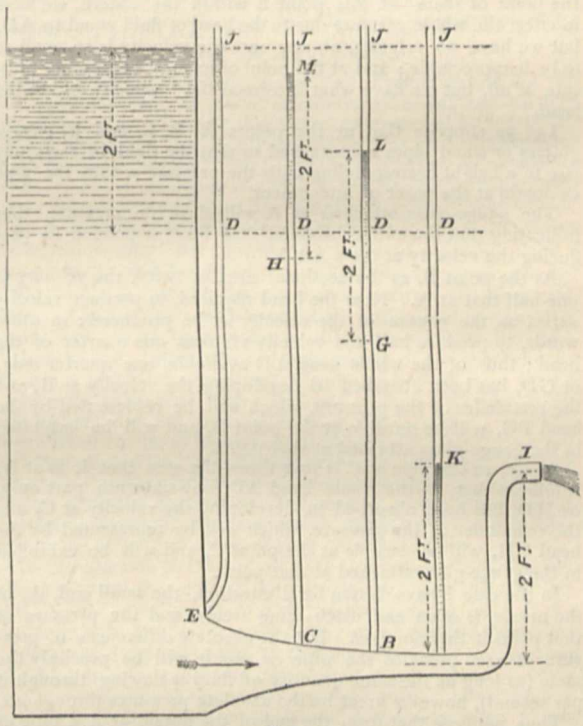


FIG. 35.

the tension on the pipe is the same as in the case of a right-angled bend. A geometrical proof of this is given in Fig. 33. It is evident that the radius of curvature of the bend does not enter into this consideration, and that the forces acting are not affected by the rate of curvature of the pipe, the simple measure of the forces being the increase or decrease in the momentum of the fluid in each direction. It results from this that if a fluid be flowing along a pipe with a bend in it, no matter what may be the angle of the bend, or the radius of its curvature, the reactions necessary to deflect the path of the fluid will be met by a tensional resistance along the pipe; and this tension is equal to the force that would be required to entirely destroy the momentum of the fluid.

If we now assume any number of bends, of any angle or curvature, to be connected together (see Fig. 3), the equilibrium of each bend is satisfied by a longitudinal tension which is in every case the same; and this tension is therefore uniform throughout the pipe; for the tension at any intermediate point in a bend is clearly the same as at the ends of the bend, as we may suppose

the bend divided at that point into two bends, and there joined together by an infinitely short piece of straight pipe.

If, then, the tortuous pipe I have above referred to has its ends at A and B parallel to one another, as shown in Fig. 4, it is clear that the tensional forces at its ends balance one another, and the pipe, as a whole, does not tend to move endways.

NOTE B.

The law regulating these changes of pressure due to changes of velocity can be best understood by considering the case of a stream of perfect fluid flowing from a very gradually tapered pipe or nozzle placed horizontally and connected with the bottom of a cistern, as shown in Fig. 34. Let us suppose that at the points B and C the sectional areas of the pipe are severally twice and four times that at the point of exit A.

At the point of exit A the fluid is under no pressure whatever, since there is no reacting force to maintain any pressure ; each particle of fluid in the issuing jet is rushing forward on its own account, neither giving nor receiving pressure from its neighbours. We know, however, what force it has taken to give the velocity which the fluid has at the point of issue A, and we measure this force by the pressure or head of fluid, lost. In the case we are considering, this head is represented by the height of the fluid in the cistern, or by the height AD.

Within the cistern, at the point E, on the same level as A, the point of issue—at this point E within the cistern, we have in effect the whole pressure due to the head of fluid equal to AD, but we have no velocity, at any rate the velocity is so small as to be inappreciable ; and at the point of issue A we have no pressure at all, but we have what is termed the "velocity due to the head."

Let us suppose that at the points A, B, C, and E, gauge-glasses or stand pipes are attached so that the fluid in each may rise to a height corresponding with the pressure within the pipe or nozzle at the point of attachment.

The gauge-glass attached at A will show no pressure, thus indicating that the entire head AD has been expended in producing the velocity at the point A.

At the point B, as the sectional area is twice, the velocity is one-half that at A. Now the head required to produce velocity varies as the square of the velocity to be produced ; in other words, to produce half the velocity requires one quarter of the head ; thus of the whole head AD available, one quarter only, or GD, has been absorbed in developing the velocity at B, and the remainder of the pressure, which will be represented by the head BG, will be sensible at the point B, and will be exhibited in the gauge-glass attached at that point.

Again, as the pipe at C is four times the area that it is at A, it follows that, of the whole head AD, one-sixteenth part only, or HD, has been absorbed in developing the velocity at C, and the remainder of the pressure, which will be represented by the head CH, will be sensible at the point C, and will be exhibited in the gauge-glass attached at that point.

In the case I have chosen for illustration, the small end, A, of the nozzle, is open and discharging freely, and the pressure at that point is therefore *nil*. But the absolute differences of pressure at each point of the pipe or nozzle will be precisely the same (as long as the same quantity of fluid is flowing through it per second), however great be the absolute pressures throughout.

Thus, suppose that from the end of the nozzle at A a pipe of the same diameter, and of uniform diameter throughout its length, is curved upwards, so that the end of it, I, is two feet higher than A, as shown in Fig. 35, if the level of the cistern is also raised two feet, namely to the level marked J, instead of D, we shall have the same delivery of fluid as before ; and the differences between the pressures at each point will be the same as before.

If we add 50 feet instead of 2 feet to the head in the cistern, and raise I to 50 feet, instead of 2 feet above the nozzle, the differences of head or pressure will still be the same, the head at A being 50 feet, that at B being BG + 50 feet, that at C, CH + 50 feet, and that at E (the cistern-level) ED + 50 feet.

To put the case into actual figures, suppose the sectional area at A to be 1 square inch, that at B 2 square inches, and that at C 4 square inches, and suppose that the fluid is passing through the nozzle at the rate of one-ninth of a cubic foot per second, we shall have a velocity at A of 16 feet per second, to generate which would require a difference of pressure between E and A, equivalent to 4 feet of vertical head. The velocity at B will be 8 feet per second, which would require a difference between E and B equivalent to 1 foot of head. That at C will be 4 feet per second, and will require a difference of pressure equivalent to 3 inches of head. If the pressure at A be zero, the pressures at B, C, and E will be 3 feet, 3 feet 9 inches, and 4 feet respectively. If the pressure at A be 1 foot, the pressures at B, C, and E will be 4 feet, 4 feet 9 inches, and 5 feet respectively ; and if the pressure at A be 1,000 feet, the pressures at B, C, and E will be 1,003 feet, 1,003 feet 9 inches, and 1,004 feet respectively, always supposing the quantity of fluid passing per second to be the same. If the quantity be different, the absolute differences of pressure will be different, but will be relatively the same. If, for instance, the quantity flowing per second be doubled, the velocity at each point will be doubled, and the differences of pressure quadrupled ; so that if the pressure at A were again 1,000 feet, those at B, C, and E would be 1,012, 1,015, and 1,016 feet respectively.

To sum up—the differences of hydrostatic pressure at different points vary as *the differences of the squares of the velocities* at those points.

NOTE C.

Here again the argument given in the text suggests certain other lines of argument which some persons may feel interested in following out

Suppose each and every one of the streams into which we have subdivided the ocean, to be inclosed in an imaginary rigid pipe made exactly to fit it, throughout, the skin of each pipe having no thickness whatever. The innermost skin of the innermost layer of pipes (I mean that layer which is in contact with the side of the body), the innermost skin, I say, of this layer is practically neither more nor less than the skin or surface of the body. The other parts of the skins of this layer, and all the skins of all the other pipes, simply separate fluid from fluid, which fluid, *ex hypothesi*, would be flowing exactly as it does flow if the skins of the pipes were not there ; so that, in fact, if the skins were perforated, the fluid would nowhere tend to flow through the holes. Under these circumstances there clearly cannot be any force brought to bear in any direction by the flow of the fluid, on any of the skins of any of the pipes except the innermost skin of the innermost layer. Now, remembering that we are dealing with a perfect fluid which causes no surface-friction, we know that the fluid flowing through this system of pipes administers no total endways force to it. But it produces, as we have just seen, no force whatever upon any of the skins which separate fluid from fluid ; consequently, if these are removed altogether, the force administered to the remainder of the system will be the same as is administered to the whole system, namely, no total endways force whatever. But what is the remainder of the system ? Simply the surface of the body, which is formed, as I have already said, by the innermost skins of the innermost layer of pipes. Therefore no total endways force is administered to the surface of the body by the flow of the fluid.

Lastly, let us recur for an instant to the case of fluid flowing through the single flexible pipe. Here it was proved that the flow of the fluid through it, if it was anchored at the two ends, did not tend to displace any part of it, because the centrifugal forces produced by the flow of the fluid, and which must act exactly at right angles, or normally, as it is called, to the line of pipe at each point, are exactly counterbalanced by a uniform tension throughout the length of the pipe. If the flexible pipe has variations in its diameter, the differences of quasi-hydrostatic head appropriate to those variations are also normal to the surfaces of the pipe, being simply bursting-pressures. If, however, these normal forces were directly counterbalanced by equal and opposite and normal external forces or supports, it is obvious that this tension would be entirely relieved. Now, if we suppose the system of pipes which we have several times already imagined to surround the submerged body, to be flexible pipes (instead of rigid pipes, as we have before imagined them), the counterbalancing, or normal, external forces which exactly relieve the tension are supplied to each pipe by its neighbour, except in the case of the innermost skin of the innermost layer of pipes, since this innermost skin has no neighbour. In this instance the counterbalancing, normal, external forces are supplied by the rigidity of the surface of the body. Now we know that, since the tensional forces produced by the flow of fluid through a flexible pipe, whether of uniform or varying sectional area, have no sum total of endways force, the counterbalancing forces which exactly relieve this tension must also have no total endways force ; and since the counterbalancing forces acting throughout the whole system have thus no sum total of endways force, it can be proved, as before in the case of the similar system of rigid

pipes, that if we remove the whole of the skins or sides of pipes, which separate fluid from fluid and which are all therefore necessarily in perfect equilibrium, the forces acting on the remainder, namely, on those skins which are in contact with the surface of the body, forces which therefore may be considered as acting simply upon the body, must also have no endways sum total.

THE MELBOURNE OBSERVATORY

THE Board of Visitors to this Observatory made its annual visitation on June 2, 1875. Mr. Ellery, the Government Astronomer, having obtained leave of absence, the Board found the staff of officers and all the instruments in charge of Mr. White, in whose management it unhesitatingly expresses its fullest confidence.

The buildings and instruments are in good condition, and several new and important instruments have been added to the establishment during the period under notice. These include a photo-heliograph from Dallmeyer, of London, who constructed it under the advice of Dr. Warren de la Rue; an equatorial refractor of eight inches aperture, made by Troughton and Sims, under the advice of Sir George Airy; a portable equatorial, of 4½ inches aperture, by Messrs. Cook and Son, of York; and a double-image micrometer by Mr. Browning.

The various publications of the Observatory are in a forward condition. The First Melbourne General Catalogue of 1,227 Stars, for the epoch 1870, was published early in October, in time to be distributed among the different parties charged with the observation of the transit of Venus, by whom its great utility was acknowledged.

The observatory staff had much work to do in connection with the observation of the transit of Venus, not only having to make the necessary preparations for observing the transit at their own stations, but also to assist with the requisite observations for finding the positions of the stations occupied by the different nations in that part of the world. The arrangements made by the Observatory were all that could be desired.

With regard to the ordinary work of the Observatory, Mr. White reports as follows:—

"The work with the transit circle has consisted of the usual standard stars for finding the time, and the position of the instrument; close circumpolar stars, low stars for refraction, stars with which bodies had been compared off the meridian, stars culminating with the moon, the moon itself, and stars whose places were required by outside observers for any special purpose.

"The numbers of the recorded observations are as follows:—R.A. observations, 2,064; P.D. observations, 1,150; Observations of error of collimation, 111; observations of error of level and nadir, 180; observations of error of runs of microscopes, 47; observations of error of flexure, 35.

"The state of the reductions is as follows:—

"R.A. observations up to date.

"P.D. observations.—The stars observed in 1873 are reduced with the exception of 212, which require the corrections to reduce them from their apparent to their mean places. Of the stars observed in 1874, 865 are wholly unreduced, 267 have the reductions applied as far as the refraction, 45 are reduced to their apparent places, and the remaining 45 are fully reduced. Of the stars observed during the present year, 184 are fully reduced, 46 are reduced to their apparent places, and 122 are wholly unreduced. . . .

"The magnetical and meteorological instruments are under the special charge of Mr. Moerlin. Absolute values of the magnetic elements have been made as usual once a month, and they are all reduced up to date. The photographic curves from the magnetographs, barograph, and thermographs, are developed on every alternate day, but as yet no general tabulation of them has been made; only occasional measures are taken from them for special purposes. The ordinary meteorological observations made at Melbourne and the different stations in the colony are reduced to date; the Monthly Records in Meteorology and Magnetism are prepared to the end of April, and are in the printer's hands; owing to press of work, however, in the Government Printing Office, the Records to the end of December 1874 only have as yet been received. The Yearly Report for 1873 is in hand, and that for 1874 will be prepared as soon as possible.

"The great telescope, under the especial charge of Mr. Turner, has been diligently worked during the last twelve months, except during the time that we were engaged in the special observations connected with the transit of Venus, when Mr. Turner took turns with Mr. Moerlin in observing the occultation of stars by the moon. In accordance with the strongly expressed opinion of the Board in the last Report, the work done has consisted principally of drawing the nebulæ, and mapping the neighbouring stars; ten of the nebulæ and clusters figured by Sir John Herschel have been carefully drawn, and the positions of the stars have been laid down from micrometric measurements. One nebula has been observed which is not to be found in any catalogue in our possession. Coggia's comet was examined on eighteen nights, and fifteen drawings of it obtained. A drawing of the nebula surrounding η Argus, with the stars accurately plotted in, made this year, shows no appreciable change when compared with the one made last year.

"Besides the occultation of stars by the moon, referred to before, and of which ninety-six were looked out for, and only fifteen observed, owing to the unfavourable weather of the time, a fine series of observations for positions of Coggia's comet was obtained by Mr. Ellery and myself; an observation of Encke's comet was also obtained during the present month; all of which, including the occultations, have been sent for publication to the *Astronomische Nachrichten*."

The Report concludes with a brief account of the results obtained at the four Government stations during observations of the transit of Venus.

PROF. PARKER ON THE WOODPECKERS AND WRYNECKS

ANOTHER admirable paper by Prof. Parker, exhibiting the same industry, successful elucidation of detail, and mastery of morphological principle that have characterised all his publications, appears in the recently-issued volume of "Transactions of the Linnean Society." It is chiefly devoted to an exposition of the palatal structures of the Picidæ and Yungidæ, made intelligible by the study of nestlings and young birds. The conclusions of Prof. Huxley in his paper in the "Proceedings of the Zoological Society" for 1867 are substantiated and placed on a broader basis; and thereby another chapter has been permanently added to the history of the connection between Reptiles and Birds. The assistance which scientific naturalists all over the world may render to necessarily sedentary students like Mr. Parker, by the preservation and transmission of young specimens of various ages, is nowhere more clearly manifested than in the paper now spoken of. Mr. Parker's study of Woodpeckers, both of hard and soft parts, dates from the year 1843; and the unpublished results of that labour, in the form of minutely-careful drawings, are still of considerable value for reference. Again and again the study was resumed, with somewhat unsatisfactory results, until the opportunity of dissecting young birds and of comparing them with southern species threw sufficient illumination on the difficult problem of their palatal structure.

An introduction to the paper serves to point out the proper relations between the zoologist and the embryologist. "Each kind of labourer," says Prof. Parker, "has the greatest need of the results brought out by the other: the patient dissector waits for the treasures supplied to him by the more mercurial taxonomist; whilst he, in turn, profits by the work of one to whom a single type may serve for the labour of a year or more. Yet both are learning to look beneath the surface of things, a growing knowledge of the types showing both that close kinship is often marked by great difference in outward form, and that it is easy to be beguiled by the external likeness of forms—*isomorphic*, indeed, but far apart zoologically."

A defence is made against those who would accuse the author, as well as Prof. Huxley, "of taking a narrow view of the bird-types, touching with the point of a needle some little tract, but unacquainted with and not able to appreciate the Bird as a whole." Such an accusation charges the broadest-minded men with possessing a cast of mind which would utterly disqualify them for the distinguished positions they hold. In the present case the exclusive description of the palatal structures is easily defended: for "that territory contains parts that have undergone the greatest amount of metamorphosis of any in the whole body of a high and noble vertebrate; and moreover, being in the bird the skeletal framework of the whole upper face, these parts are, as it were, an index of the amount of specialisation undergone by any particular type—the ruling determining structures that lead to all, and really demand all, the changes that take place in the rest of the organism."

Breadth of view is indeed essential, if anywhere, in such an investigation as the present. A restricted insight and experience would fail to detect and to demonstrate the substantial unity of structure existing in the palate of Lizards and of Woodpeckers, still more to establish the more minute relationships between the Rhynchosaurian Hatteria and various members of the Woodpecker group. This is what has been done. The well-defined group of the Woodpeckers, including the sub-family of Wrynecks, is so connected by its embryonic and adult palatal structures with the Lizards, that the name "Saurognathæ" is to be substituted for the morphologically-unexpressive term "Celeomorphæ," applied to them by Prof. Huxley. Their palatal region is arrested at a most simple and Lacertian stage, whilst in other respects they are metamorphosed and specialised beyond any other kind of birds.

The characteristics of the Saurognathous type of palate may be summarised as follows:—Retention and ossification of trabecular cornua; great number and bilateral independence of the vomerine series of bones, some of which are azygous (vomers, septo-maxillaries, median septo-maxillary); absence of a distinct mesopterygoid, represented, however, by a long process; a dagger-shaped basipalatine between the right and left bones; absence of a distinct transpalatine; abortive development of maxillo-palatine plates, and presence of a distinct palato-maxillary on the left side only.

One of the most instructive specimens figured is *Picumnus minutus*, a woodpecker from Bahia, Brazil, of about the size of the Golden-crested Wren. In it the vomers retain in the adult the condition manifested in the young of the Green Woodpecker, and much resembling the vomers of Hatteria. In other respects it presents resemblances to various Passerines of its own zoological area; and from it the author's imagination is led down to extinct types in which the characters of the Hemipod, the low Passerine, and the Woodpecker were existent in one generalised form—a form and a type only a step or two above the Ostrich tribe.

Numerous hints are given in this paper which lead us to look with great interest for Prof. Parker's forthcoming paper on the Ægithognathæ (Passerines) in the Zoological Transactions; and we may fitly close this notice with a pregnant passage referring to the Ægithognathous palate, showing to what problems of surpassing import these researches are supplying an answer. "I have long been familiar with its more marked peculiarities; but its morphological importance dawned upon me when I saw that the parts of that complex face, so conjugated and so metamorphosed, were really built up of elements which had their true counterparts or "symmorphs" in the Snake. But the Snake does but repeat these parts from the Amphibia; and the Amphibia borrow them from the Cartilaginous Fishes, amongst the lowest of which, namely the Lamprey, may be found the fullest development, both morphologically and functionally, of cartilages that form the substratum of the most peculiar part of a sparrow's face."

NOTES

AT the meeting of the Zoological Society, on Tuesday next, Prof. Huxley will read an important paper on the Anatomy of *Ceratodus* and *Chimæra*, and on the Classification of Fishes.

AT the recent anniversary meeting of the French Geographical Society M. Maunoir, the General Secretary, gave a highly satisfactory report. The receipts of the Society exceed 70,000 francs; ten years ago they were only 28,000. The number of members admitted from the beginning of the year is about 350, and about 1,400 are now registered. The receipts from money taken at the doors of the Geographical Congress and from donations, amounted to 175,000 francs, and the expenses to 155,000; a sum of 20,000 francs remaining in the hands of the Society will be devoted to the publication of the congressional papers. The place of meeting of the next congress has not yet been decided upon; it will probably be St. Petersburg.

THE *Daily Telegraph* publishes further details concerning Lieut. Cameron's expedition obtained from the Madeira correspondent of the paper. Cameron, it seems, intended to remain at Loando until an opportunity arrived for sending his men home round by the Cape to the East Coast. It is understood that the traveller has accumulated some very valuable geographical materials, besides a large amount of general scientific information. It appears that he followed a large river flowing out of Lake Tanganyika in a south-westerly direction, tracing its whole course till he came upon a new lake, which he named "Livingstone." From this body of water a second large river runs westward, which Cameron, having traced it for a considerable part of its length, believes to be the Congo. It would seem that he was unable to continue along the river on account of meeting with a tribe of hostile natives. He had to choose between fighting his way through these unfriendly natives, with the risk of losing all his journals and papers, or of taking a different direction. The latter alternative seemed preferable, and though it prevented the absolute verification of his important discovery he has personally no doubt that the stream flowing out of the Livingstone Lake and the Congo are one and the same.

THE *Birmingham Gazette* understands that Sir Josiah Mason is about to make another very substantial gift to the new scientific college which he is now building at Birmingham. When the foundation-stone was laid in February last it was understood that the mere building of the college would cost 100,000*l.*, and Sir Josiah also transferred to trustees, as an endowment for the college, the piles of buildings in which his monster pen manufacture had so long been conducted. Now Sir Josiah is also about to hand over to the trustees the business itself, or rather the whole amount which he is about to receive for the concern, and which is expected to be about 100,000*l.* The whole of this sum, it is said, Sir Josiah intends to give to the college. The money will probably be invested in the names of the local gentlemen who have already been appointed trustees, and will form a permanent endowment for the institution.

A PRIVATE gentleman, being about to make a voyage to the West Indies in pursuit of objects of interest in natural science, has arranged to avail himself of the companionship and scientific services of the Rev. H. H. Higgins, of Liverpool. He will probably be away about four months cruising about the islands, and he will take with him two gentlemen—one a draftsman, and the other a collector, from the William Brown Street Museum, Liverpool. The expedition is made expressly for observations and collections in zoology and botany, and Mr. Higgins will have an opportunity of carrying on dredging operations. Very advantageous terms have, we believe, been arranged as to the division of the treasures which will be the result of the voyage. Mr. Higgins will be glad to receive suggestions with regard to the work he is about to undertake.

THE scientific public will be glad to learn that a movement has been set on foot to enlarge the existing Wigan Mining and Mechanical School, inaugurated eighteen years ago by Dr. Lyon Playfair, and now numbering nearly 200 evening students. At a public meeting held at Wigan on the 24th inst., attended by nearly all the colliery proprietors of the district, resolutions were passed, resolving to establish a permanent building with museum, laboratory, and all the appliances for giving a thorough technical education in Mining, Mechanics, Geology, Machine Construction, Steam, and Chemistry. Large subscriptions have already been promised, including 1,000*l.* from Lord Crawford and Balcarres, 500*l.* from Mr. Hewlett, the Managing Director of the Wigan Coal and Iron Company, who promise 125*l.* a year.

ON Monday the Prince of Wales opened the new Zoological Garden at Calcutta, recently formed under the auspices of the Lieutenant-Governor of Bengal.

THE Municipal Council of Paris has voted a handsome sum of money in support of the State Academies of Paris. The vote was carried by twenty-three against nineteen. The minority was composed of clericals who are opposed to the instruction given by Government, and ultra-republicans, who are opposed to the grant of any money for superior instruction.

CAPT. MOUCHEZ leaves Paris shortly to command the war vessel which is to complete the Hydrographical Survey of the Algerian coast. The expedition is expected to be away for a full year.

MR. HENRY WILLETT, the hon. secretary of the Sub-Wealden Exploration, has issued his 14th quarterly report. He states that the contractors are laudably endeavouring, at their own cost, to enlarge the bore-hole, so as to enable them to reach 2,000 feet and to produce cores undeniably satisfactory to the promoters. Mr. T. Warner, of Brighton, is willing to contribute 400*l.* in all for the next 500 feet after 2,000 feet. The ultimate decision as to the continuance of the work will rest with the central committee in London, who will, of course, be guided mainly by the question of finance.

INTELLIGENCE received at Madrid on the 28th from the Philippines announces that a terrible hurricane swept over the provinces of Albay and Camarines, in the southern part of the Island of Manilla, on the 30th of November. Two hundred and fifty persons are stated to have been killed, and 3,800 inhabited houses, the crops, and a considerable number of animals were destroyed. General consternation prevailed in Manilla.

THE French Society of Ethnography has granted its great medal to the memory of Doudard de Lagrée, the organiser of a scientific exploration on the banks of the Mekong in Indo-China.

THE official paper of the Governor-General of Algeria announces that the Algerine Meteorological Board has completed its organisation and will be very shortly placed in communication with the international service presided over by M. Leverrier. Weather telegrams from various places will be sent daily.

THE Academy of Sciences held its anniversary meeting on Monday. M. Bertrand delivered an *éloge* on General Poncelet, the great geometer and mathematician, who died twelve years ago, leaving a number of most valuable books, of which a general edition has been published recently. Amongst the prizes distributed was one to M. Denayrouze for his apparatus for working in mines and for submarine explorations.

THE cultivation of coffee in India is steadily progressing, and although the introduction of the plant into the eastern portions of the country is of ancient date, it is only within the last twenty years that much attention has been given to its production. The principal plantations are situated in Mysore and the Neilgherry Hills, at an elevation of 3,000 to 4,000 feet above the level of the sea. The climate of these districts, besides being well adapted to the cultivation of the coffee-plant, is not so injurious to the health of Europeans as many other parts of the country, and it is probable that the industry will be largely developed. In 1842 the value of coffee exported from British India was 74,957*l.* Ten years later it had advanced to 84,306*l.*; in 1862 to 462,380*l.*, till in 1872 it had increased to 1,380,410*l.*

AT the same time the cultivation of tea is advancing even more rapidly, though its introduction is much more recent. The Assam tree is celebrated for its fine quality. The existence of this tea-producing country was only recognised in 1834, when Lord Bentinck introduced some Chinese growers, and the trade became firmly established. In 1842 the value of tea exported was 17,244*l.*; in 1852, 59,220*l.*; in 1862, 192,242*l.*; and in 1872, 1,482,186*l.*

THE *Journal of the Asiatic Society of Bengal*, vol. xliv. part 2, contains a paper by Capt. J. Waterhouse, Assistant Surveyor-General of India, on "Photography in connection with the Observation of the Transit of Venus at Roorkee."

THE Report of the Dundee Free Library Committee is drawn up with great care and considerable elaboration, and contains some very useful statistics as to the numbers of books issued in various departments, and the classes to which the readers belong. As might be expected the books taken out in light and miscellaneous literature are in an overwhelming majority, though those belonging to the various sciences have a creditable amount of patronage which we hope to see gradually increase. We think a more satisfactory classification of the sciences might be adopted than that contained in the Report. The Natural History Museum connected with the Library is evidently being enriched with valuable specimens, and we are glad to see the Naturalists' Society is prospering. There is also a University Club housed in the building, which numbers 140 members, and "seeks in the first instance to foster Culture and the Higher Education, with the ulterior object of cultivating public opinion in the direction of University extension in Dundee."

THE ravages of the Phylloxera among the vines have caused many attempts to be made to discover a new kind of beverage which might take the place of the juice of the grape. The Marquis de Villeneuve reports that in China a *pseudo* wine called *Tsien-ia* is much used, which is concocted from a preparation of four plants, common in that country, and mixed together in certain proportions. The plants are dried and powdered, and made into a paste, which is sold in the form of balls or squares at the rate of about 3*d.* a pound. One square or ball will make several pints of a fermented liquor, pleasant to the taste and much resembling wine, which is much sought after by Europeans and others living in China. A factitious brandy is also prepared in the same way, and the manufacture is so simple that with a capital of 5*l.* or 10*l.* to purchase the apparatus, a man may make twenty-five gallons of "brandy" a day. The Marquis de Villeneuve affirms that the "wine" thus produced is of good quality and possesses no injurious ingredients.

PART 2 vol. i. of the "Transactions of the Watford Natural History Society" is to hand, containing the four papers read on May 13 last, besides a number of miscellaneous notes and observations.

MR. G. H. KINAHAN has published a paper read by him at the Royal Historical and Archæological Association of Ireland, on some prehistoric antiquities in the neighbourhood of Drumdarragh, Co. Antrim.

ABOUT a year ago we noticed the publication by the New England Society of Orange of the "Babbit Portfolio," containing some beautiful photographs of remarkable trees in the neighbourhood of Orange. The same Society has recently issued the "Haskell Portfolio" (after a well-known citizen of Orange), containing photographs of other fine trees, even finer in execution, we think, than the previous ones. The trees represented are the Condit Chestnut (*Castanea vesca*), the Sugar Maple (*Pyrus malus*), the Park Tulips (*Liriodendron tulipifera*), and the Essex Maple (*Acer rubrum*).

WE have received the Report of the first Annual Conference and Exhibition of the Cryptogamic Society of Scotland, held at Perth on Sept. 29, 30, and Oct. 1; both conference and exhibition seem to have been a complete success.

STATISTICIANS calculate that there are now in work some 200,000 steam-engines, with a total power of 12,000,000 horses, corresponding to the muscular strength of 100,000,000 men.

ALMOST all the Carthaginian antiquities which had been sunk with the *Magenta* have been recovered by Denayrouze's diving apparatus and submarine lamp.

THE additions to the Zoological Society's Gardens during the past week include a Black Lemur (*Lemur macaco*) from Madagascar, presented by Captain Burke; a White-fronted Lemur (*Lemur albifrons*) from Madagascar, a Night Parrot (*Stringops*

habroptilus) from New Zealand, a Grey Ichneumon (*Herpestes griseus*) from India, deposited; a Yellow Baboon (*Cynocephalus babouin*) from W. Africa, purchased; a Gavial (*Gavialis gangeticus*) from India, presented by Capt. Barnet: a Common Fox (*Canis vulpes*) European, presented by Mr. W. Saville.

SCIENTIFIC SERIALS

THE *Journal of the Royal Agricultural Society of England*, Second Series, No. xxii.—The contents of this number are most attractive. To science is assigned the leading place in the arrangement. The first paper is devoted to the Colorado potato-beetle, and is from the pen of Mr. Bates, F.L.S., who does not profess to impart any original information, and who is unable to come to any definite conclusion as to the probability of its appearing in these countries. The paper is calculated to confuse rather than to enlighten us on this point. For while in one place the author goes to show that the possibility of living specimens arriving here cannot be doubted, he observes elsewhere that the analogies of the case supply ground for confidently believing that there is exceedingly little probability of their propagating and spreading in this country. We are also told that "the creature has developed extraordinary flexibility of constitution and habits since it left its quiet home in the Rocky Mountains, and that we cannot be quite sure what it will eventually do." In another passage Mr. Bates says:—"The potato-beetle is no insidious enemy, like the majority of insect plagues, but meets the farmer in open fair fight." What does he mean by a fair fight between an insect which destroys whole fields and districts, and the helpless farmer?—Mr. Carruthers, F.R.S., consulting botanist to the Society, contributes a paper and a note on the potato disease. In the "paper" he reports on what he calls the results of the competition for the prizes offered through the Society in 1874 for potatoes which would resist the disease for three years in succession. The "note" gives a brief account of Mr. Worthington Smith's discovery of the resting spore of the potato fungus. The paper must have been written before the discovery. The truth is the discovery throws a curious shadow not only on the paper but on the course pursued by the society in connection with the whole subject. We were not quite prepared to find that the consulting botanist of this great society would be permitted to announce, as he has done in this paper, that in investigating this disease we must summarily dismiss the soil from our consideration. "Neither soil, nor methods of cultivation," we are told, "exercise any influence on the prevalence of the disease." For the present we can only say these statements are as unsound as they are astounding. The *Journal* contains a long paper on laying down land to permanent pasture, which is a joint production. The bulk of the information is given second-hand; that is to say, on information furnished by several agriculturists, a long paper is based by the joint authors. The number contains too much matter of this character. The views of an American naturalist on the Colorado potato-beetle are given in a paper by Mr. Bates. Mr. Carruthers seeks to enlighten us on the potato disease by information collected from various sources; and a number of scattered facts on one of the most important of agricultural subjects—the profitableness of pasture as compared with arable land—are grouped and reviewed in a great variety of ways, some of which are calculated rather to mislead than to enlighten the reader. There are several passages in the paper which will produce the impression that the gentleman to whom has been assigned the chief part of the joint authorship is not intimately acquainted with agriculture as at present practised. We take one passage as an illustration: "There are many persons so enamoured of a special rotation—say the four-course—that to extend the period of artificial grass to two years appears to them a violation of all the true principles of scientific farming. The four-course is their ideal of modern farming. A course of cropping which has been proved highly beneficial on some of our most famous corn-growing districts is supposed to be the only legitimate system to be pursued by intelligent farmers elsewhere." Who are the persons referred to? It may be well to remind the gentleman who wrote this paper that English farmers are calling out for more freedom of action in the cropping of their land, and that for several years past vast numbers of them have been doing that which he would appear to have discovered in 1875. We cannot at present make room for further criticism on this paper; and we are glad to be able to state that the number contains several meritorious articles.

THE *Journal of the Chemical Society* for November contains Dr. Hofmann's Faraday lecture, entitled "The Life-work of Liebig in Experimental and Philosophic Chemistry; with allusions to his influence on the development of the collateral sciences and of the useful arts." The lecture is illustrated by a portrait of Liebig, and an autotype copy of a letter from Liebig to Faraday.—Prof. J. W. Mallet contributes a paper on achrematite, a new molybdo-arsenate of lead, and Mr. W. J. Lewis a note on the crystallography of Leucaurin, being an appendix to a former paper by Messrs. Dale and Schorlemmer.—The journal contains its usual number of valuable abstracts from foreign periodicals.

Morphologisches Jahrbuch.—In the second part of this journal Dr. B. Solger discusses the homology of the cervical vertebræ and nerves in the Sloths, and concludes that the vertebræ up to the 22nd are homologous in Cholœpus and Bradypus, but that the homologies of the first twelve nerves cannot be determined; the nerves from the 13th to the 23rd are homologous.—Another paper by Dr. Solger describes two cartilaginous pieces in the visceral skeleton of *Chimæra monstrosa*, which appear to have been hitherto unnoticed.—Dr. Hermann Fol gives an account of the so-called endostyle of Huxley in various genera of Tunicata, and appears to establish it satisfactorily as a slime-gland. Excellent figures of its ciliated and glandular epithelia are given.—Prof. Gegenbaur devotes twenty-two pages to a consideration of the omohyoid muscle, which he believes to be a remnant of a continuous muscle whose origin extended from the sternum along the clavicle to the scapula. He also gives an account, with microscopic sections, of the nipples in *Didelphys* and in *Mus decumanus*.—Dr. Carl Hasse's paper on *Amphioxus lanceolatus* is devoted to a demonstration of the structure of the eyespots, in which he finds cells which may be designated optic cells, as distinguished from the pigment-cells.—Prof. Gegenbaur occupies forty-seven pages with a detailed and very hostile criticism of Götte's recently-published work on the Development of the Toad as a basis for the Comparative Anatomy of the Vertebrata. He censures it in very many respects as empirical and unscientific.

Jahrbuch der kais.-kön. geologischen Reichsanstalt, band xxv. No. 2.—In this number of the Jahrbuch, Dr. E. Tietze, who has been some time in Persia, describes the springs and spring-formations that occur in Demavend mountain and its neighbourhood; most of the springs are thermal, and deposit large quantities of calcareous tufa.—The next paper gives details of the work done in the chemical laboratory of the Geological Survey, and includes upwards of 200 analyses.—Dr. C. Doelter describes the geological structure, the rocks, and minerals of the Monzoni Alps in the Tyrol. This paper is illustrated with a geological sketch-map and two plates of minerals.—Among the "Mineralogical communications" the most generally interesting paper is one by Professor Fuchs on the earthquakes and volcanic eruptions of 1874. He enumerates 123 earthquakes, distributed as follows:—Winter 37; (Jan. 12, Feb. 15, Dec. 10); Spring 32; (March 12, April 11, May 9); Summer 25; (June 7, July 5, Aug. 13); Autumn 29; (Sep. 9, Oct. 9, Nov. 11).—The remaining papers are these:—"On Sahlite as a rock-constituent," by E. Kallowsky; "On the chemical composition of meionite," by E. F. Neminar; "On Lievrite," by L. Sipócz; "On the minerals occurring in the metalliferous veins of the Pribram region," by F. Babanetk; "On rocks from the island of Samothracia," by J. Niedzwiedzki.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 9.—"On some Electro-magnetic Rotations of Bar-magnets and Conducting-wires on their Axes," by G. Gore, F.R.S.

In all the published forms of Ampère's experiment of the electro-magnetic rotation of a vertical bar-magnet or conducting-wire upon its axis by Ampère, Faraday, Sturgeon and others, the magnet or wire has either been immersed a large portion of its depth in mercury, or its middle part has been connected by a wire with a surrounding annular channel filled with mercury, and the electric current passed into or out of the magnet or wire by means of that liquid, and the mercury has formed an essential part of the arrangement.

In all published cases of rotation of bar-magnets on their axes by the influence of electric currents, the two ends of the magnet

has had *dissimilar* poles. By meditating upon certain facts connected with this subject, I concluded that, by passing a current from one end to the other of a magnetized rod or wire having *similar* poles at its two ends, the magnet would probably rotate, and experiment has demonstrated that conclusion.

Upon a thin wooden tube 15 centims. long and 7 millims. bore, I wound a cotton-covered copper wire 1·7 millim. diameter, from one end of the tube to the middle, then reversed the direction of winding, and continued to the other end and back to the middle, again reversed, and coiled to the first end of the tube; by which arrangement the passage of a current through the coils produced two similar poles at the ends of the tube, and two others of the opposite kind at the middle.

The tube being now fixed in a vertical position, a straight iron wire 15 centims. long, and 1·8 millim. diameter, pointed at its lower end, and surmounted by a brass mercury cup 5 millims. diameter, containing a drop of mercury, was supported entirely within the tube and free to rotate, by a similar cup (surmounting a fixed vertical brass rod), at the lower end of the tube; the upper end of the axial wire being kept in position by a vertical brass rod fixed above the coil and terminated at its lower end by a sharp point of platinum in the mercury cup.

A current from 6 one-pint Grove's elements, arranged as 3, being now passed through the coil, brass rods, and axial wire, the latter rotated rapidly.

A copper wire substituted for the iron one would not rotate, probably because copper is so little capable of acquiring longitudinal magnetism.

To ascertain if the coil-current simply performed the function of longitudinally magnetizing the axial wire, I took an iron wire 23 centimes. long and 2·7 millims. diameter, sharp-pointed at its lower end; soldered to its upper end a double wire of cotton-covered copper, each wire being 1·7 millim. diameter, coiled the double wire upon the axial rod in two layers, and so as to enable two *similar* poles to be formed at the extremities of the axis, and terminated the copper wires by a little brass mercury-cup just above the top end of the vertical iron axis. By supporting this apparatus as the axial wire in the previous experiment, and passing the current, rotation occurred.

Reversing the direction of the current did not reverse the direction of rotation.

These experiments, produce a striking effect in a lecture, because the rotation appears to be produced without reaction of the moving part of the apparatus upon any external or fixed body.

In each of these cases of rotation, an upward vertical current entering a lower south pole or leaving an upper one, caused the upper end of the rod to rotate in the direction of the hands of a watch, and a downward current entering or leaving a north pole also produced that direction of motion, and reversing the poles in either case reversed the effect.

In each of these instances of rotation, without the aid of a current near the middle of the magnet, the coil being so constructed that the current in it could not be reversed without reversing that in the fixed conductors near it, reversing the direction of the current did not reverse that of the rotation, because the two acting influences were reversed together, and therefore each apparatus had its own direction of rotation, either right handed (↻) or left handed,* according to the direction in which its coils were wound. It follows from this that a current, the direction of which is alternately reversed, will drive the apparatus quite as well as one in one uniform direction.

I now endeavour to increase the effect. For this purpose I substituted for the upper brass rod a fixed coil consisting of one layer of copper wire upon an iron wire axis, but having dissimilar poles at its ends and no poles at its middle part, and placed between it and the lower brass rod a right-handed one free to rotate. The opposed poles of the fixed and movable coils were of opposite kinds, *i.e.* north and south. On passing a current from a Noe's thermo-pile of 96 elements,† connected as 24, rapid rotation in a right-handed direction occurred. I now substituted for the lower brass rod another fixed coil, similar to the upper one, but of an opposite direction of polarity, and passed the current again; still more rapid rotation in the same direction took place, and the effect was very striking. In this latter instance, two south poles free to move were opposed to two fixed north poles, and in each instance the current was passed upwards.

I now substituted for the movable coil a vertical wire of iron 13 centims. long and 1·7 millim. diameter, surmounted by a small brass mercury cup; passed the current from the thermo-pile, and obtained rotation, but less rapid than before; but by inclosing this wire in the axis of a fixed coil which produced appropriate and similar poles at its two ends, as in paragraph 3, and repeating the experiment, very great velocity of rotation was obtained. Rotation of a somewhat thicker wire of nickel was also obtained, both with and without the aid of the current in the middle fixed coil. I also tried, without the aid of the middle fixed coil, and with it, a copper wire of similar dimensions to the iron one, and obtained rotation freely. Each of these rotations agreed in direction with those of the movable coil.

The apparatus represented in the annexed sketch was employed for nearly all the various modifications of the experiment, by substituting for one or more of the coils metallic wires, &c., as desired. The upper part of the brass pillar A was capable of sliding in the lower part B, and could be fixed by a screw C, which encircled the split end of the tube B. The fine adjustment was effected by means of the screw D, the lower end of which rested upon the top of a tall brass rod inside the brass pillar. The upper and lower fixed coils or rods E and F were insulated from the brass clips G and H, and the battery was attached to the binding-screws I and J. K is a binding-screw for connecting with the upper coil or rod.

I also obtained rotation of the iron wire whilst the wire was in a horizontal position, its ends resting in hollows in the ends of the iron axes of the two fixed coils, and the ends of those axes and of the movable wire lying upon the surface of pools of mercury in small watch-glasses. The movable iron wire was inclosed in the axis of a thin iron tube within a fixed coil, having appropriate and similar poles at its ends. The current from the thermo-pile produced very rapid rotation. This result proves that the rotations are not due to terrestrial magnetic influence.

As the directions of magnetic polarity, electric current, and rotation agree with those in the different forms of Ampère's experiment, and as in most, if not all, of the previously known cases of rotation of a bar-magnet or conducting-wire on its axis an electric current passes through the end of the bar or wire, it is evident that those rotations were due, not only to the portions of current in the mercury, and fixed conductors connected with it, near the middle of the magnet or wire, but also to the influence of the currents in the fixed conductors near the ends of the magnet or wire.

[*Note added September*, 1875.—It having been suggested by Professors Maxwell and Stokes that the rotation in the foregoing experiments was due to the influence either of the magnetism of the fixed magnets or of the current in the fixed conductors, near the ends of the movable wire or magnet, upon the portions of current in the cups of mercury, I diminished the internal diameter, both of the upper and lower cups, from 4 millims. to 1·75 millim., and arranged the following apparatus and experiment.

The fixed upper wire was of brass 2·5 millims. diameter and 60 millims. long; it had no coil upon it, and was used as a conductor only; its lower end terminated in a fine point of a steel needle protecting 6 millims. The lower fixed wire, also used as a conductor only, was of platinum to resist the action of the mercury; it was 2·3 millims. diameter and 75 millims. long, with a cavity in its upper end 3·5 millims. deep and 1.75 millim. diameter, and containing a thin plate of ruby in its lower part, with a minute hole in the centre for the needle point to rotate in. The movable wire was 2·5 millims. diameter and 125 millims. long, its upper half being composed of soft iron and its lower half of brass; its lower end terminated in a needle-point like that of the upper fixed wire, and its upper end had a cavity and perforated ruby plate like that in the lower fixed wire. A voltaic coil 60 millims. long and 7 millims. internal diameter, composed of four layers of cotton covered with stout copper wire, was used to magnetize the iron half of the movable wire, and fixed by means of a separate support in a proper vertical position beforehand, so as to inclose in its axis the iron wire portion only. The little cups were also each half filled with a minute globule of mercury before putting the movable wire into its place.

After adjusting the wire so as to make rotation easy, a current from 6 Grove's elements of one-pint capacity, arranged as a series of 6, also as a double series of 3, was passed through the coil and vertical wires; and the direction of the portion of the current in the coil alone, also in the vertical wires alone, was varied; but notwithstanding that plenty of current passed, no signs of rotation could be detected. These results, therefore,

* By a "right-handed" coil, I mean one the upper end of which rotates in the same direction as the hands of a watch.

† I have found this apparatus very convenient for such experiments.

strongly support the opinion that the rotation in the experiments was due to the action of the portions of the current in the cups of mercury.]

Linnean Society, Dec. 16.—Dr. G. J. Allman, F.R.S., president, in the chair.—The following papers were read:—On the structure and development of the bird's skull (part II.), by W. K. Parker, F.R.S. This and the former paper are parts of a large piece of work done by the writer in this particular field. A similar paper on the skull of Passerine birds appears in the present number of the Transactions of the Zoological Society; to be followed by another on the same subject. The writer's wish to work out a large series of well illustrated papers on the bird's face arose from the new interest given to this special research by Prof. Huxley's masterly memoir "On the Classification of Birds" (Proc. Zool. Soc., April 11, 1867), and his paper "On the Classification and Distribution of the Alectoromorphæ" (Ibid, May 14, 1868). The writer has worked out this subject in two ways, viz., by exhaustive work at one type of skull, making research in every part, and also by taking a part of the skull, the fore-face, and comparing this part in many types. The present paper is a piece of the latter kind of work, but begins with some new embryological details to serve as a supplement to his memoir on the fowl's skull (Phil. Trans., 1869); and this especially with regard to the development of that most interesting but puzzling bone, the "columella auris." This is shown to be developed in the house-martin (*Chelidon urbica*) in the same manner as in the reptilia. As Prof. Huxley sought, in his memoir, to give a morphological classification of birds based on the cheeks and palate, it has been the wish of the writer to carry on his friend's work, and to test it as well as extend and give it form and body. In the present paper the meaning of the peculiar structure of the face in crows, sparrows, warblers, &c. (Prof. Huxley's Coracomorphæ), is sought to be made plain by reference to the development and metamorphosis of the parts. In these the single vomer of the adult is shown to be constructed out of four bones and two cartilages; and all this composite structure is seen in them to be fused with the nasal capsule. This form of face, the most specialised of any of the class is called the "Œgithognathous" face or palate; and the huge army of birds possessing it are called "Œgithognathæ." Thus we have two terms for the group; first, a zoological "Coracomorphæ;" and second, a morphological "Œgithognathæ;" and these two groups are almost superimposable. In other birds, however, with open palates, the "Schizognathæ;" or with strongly closed and united palates, the "Desmognathæ," the zoological and morphological groups are not capable, in many instances, of being laid fairly the one on the other. Prof. Huxley put the Goatsuckers and Humming-birds amongst his "Œgithognathæ;" in the present paper they are shown to be as truly schizognathous as the Fowl or the Plover. In this paper the skull of these two types is largely illustrated. Many kinds of the desmognathous type of palate are described and figured, and their varieties explained. This is largely done with the birds of prey, amongst which the writer puts the Cariama (*Dicholophus*). Lastly, the schizognathous face is illustrated in the skull of the Sea-mew. Birds of the Gull tribe are shown to arise from the specialisation of the Plover type; they are a high kind of Charadrian bird. An interesting discussion followed, in which Dr. P. L. Sclater and Dr. Murie took part.—Notes on the plants collected and observed at the Admiralty Islands March 3–10, 1875, by Mr. H. N. Moseley.—On a sporl of *Paritium tricuspe*, by Dr. C. King.—Supplement to the enumeration of the fungi of Ceylon, by the Rev. M. J. Berkeley and Mr. C. E. Broome. Two interesting new genera are here described, *Endocalyx* and *Actiniceps*, possibly intermediate between Myxogastres and Trichogastres.

CAMBRIDGE

Philosophical Society, Nov. 29.—The following communication was made to the Society on the temperatures observed in a deep boring at Speremberg near Berlin, as given in a report of a paper by Professor Mohr, of Bonn, by Mr. O. Fisher (NATURE, vol. xii. p. 545). The greatest depth recorded is 3390 feet. The temperatures are given in Reaumur's scale. The author showed that the equation

$$v, = -\frac{251}{10^8}x^2 + 0{\cdot}012982x + 7{\cdot}1817,$$

in which v is the temperature, and x the depth, exactly represents the temperature curve. This curve will give a maximum temperature of

$$40^0.7532 \text{ R., or } 123^0{\cdot}6947 \text{ Fah.,}$$

at a depth of 5171 feet. If there was no cause to disturb the temperature, it ought to conform to a straight line, given by the above equation altered by omitting the term in x^2. Consequently a cause was sought which would change such a straight line to the parabolic form. The first cause examined was a change in the conductivity of the strata depending on the depth, and it was found that a law, which would make the conductivity vary inversely as the distance of any point above the level of greatest temperature, would account for the observed facts. But it was argued that such a law was entirely improbable. The next cause examined was the effect of the percolation of meteoric water through the strata, and the result was found to be that this circumstance would account for the observed temperatures, provided the quantity of water which passed through the rock in a unit of time bore a certain ratio to the quantity of rock passed through. The quantity of water requisite to produce the effect had not been determined. It was remarked that the results of this investigation make it appear that the true law of underground temperature would be better obtained from borings of moderate than of very great depth, because the disturbance of the temperature curve from the rectilinear form is greater the further we descend.

MANCHESTER

Literary and Philosophical Society, Nov. 8.—Alfred Brothers, F.R.A.S., in the chair.—The fauna of Cymmeran Bay, Anglesea, by John Plant, F.G.S. (part 2).

Nov. 30.—Edward Schunck, F.R.S., president, in the chair.—On the estimation of very small quantities of lead and copper, by M. M. Pattison Muir, F.R.S.E., Assistant Lecturer on Chemistry, Owens College.—On certain circumstances which affect the purity of water supplied for domestic purposes, by M. M. Pattison Muir, F.R.S.E., Assistant Lecturer on Chemistry, Owens College.

BERLIN

German Chemical Society, Dec. 13.—A. W. Hofmann, president, in the chair.—Lothar Meyer described an experiment to show that iodine does not fuse in a vacuum-tube but only in tubes filled with air; pressure being a condition of its fusion.—E. Schunck and H. Roemer have found a new isomeride of alizarine in the residues of the manufacture of the latter body. It is soluble in cold baryta-water with a dark red colour, likewise in lime-water. Its power of crystallisation is very great; but for dyeing purposes it is useless.—L. Friedburg compared various methods for purifying sulphuret of carbon. For manufacturing purposes he recommends distillation over palm-oil; but to obtain it chemically pure he prefers the action of fuming nitric acid, which attacks the impurities only, but not the sulphuret of carbon. At the same time a violet substance is formed. Sulphuret of carbon dissolves nitrous, hyponitrous, and sulphurous acid gas.—A. Flückiger has studied the explosive decomposition of white precipitate mixed with iodine.—E. de Souga heated the amalgams of silver and of gold to the temperature of boiling sulphur and found that at this temperature they retained a considerable proportion of mercury.—V. Merz and K. Schellenberger proved cyanogen to be able to produce substitution in aromatic hydrocarbons.—F. Beilstein and A. Kurbalow described the preparation of dichloraniline and of trichloraniline by passing chlorine into a solution of aniline in acetic acid.—W. Michler has succeeded in forming a urea with four ethyl groups, replacing its four atoms of hydrogen, by passing oxychloride of carbon into diethylamine. This compound, tetra-ethylated urea is a liquid, and this fact explains that it has been overlooked by former investigators.—Aug. Laubenheimer described metachloronitrobenzol and its derivatives, viz. a chlor-azobenzol, chlor-hydrazobenzol, and chlor-oxazobenzol; compounds distinguished by their power of crystallisation.—H. Scheiding has transformed bromonitro-napthylamine (alpha) by oxidation into phthalic acid, and draws conclusions from this fact to explain its constitution.—L. Jackson has prepared a brominated bromobenzol and a brominated soluidine.—C. Liebermann and Gissel have investigated the relationship between two compounds, viz., chrysophanic acid, $C_{14}H_6(OH)_2O_2$, contained in rhubarb and other plants (isomeric with alizarine); and of chrysaminic acid, $C_{14}H_2(NO_2)_4(OH)_2O_2$, a product of the action of nitric acid on aloes. It has generally been supposed that the latter substance is a nitro-substitution compound of the former. This, however, is now proved to be erroneous. Hydrochrysammine, the reduction-product of chrysaminic acid is now proved to be

$$C_{14}H_2(NH_2)_4OH_2O_2 (= C_{14}H_{12}N_4O_3),$$

and not $C_{14}H_{12}N_2O_6$, as formerly stated by Dr. Schunck. The

sulphate of this body, treated with nitrous acid, yields *a new isomeride* of alizarine, called chrysazine, and not chrysophanic acid, as would be the case if the former view were correct. At the same meeting, therefore, two new isomerides of alizarine have been announced, and thus of eight isomerides considered possible according to present views, seven have actually been discovered.

VIENNA

Imperial Academy of Sciences, Oct. 14.—The following papers, &c., were communicated:—Description of a new air-ship, by M. Codron.—The crania of the Novara collection, by M. Zuckerhandl.—Notes from the chemical laboratory of Innsbruck University, by M. Barth and others (treating of the action of fuming sulphuric acid on benzo-sulpho-acid and benzo-disulpho-acid, some derivatives from ellagic acid, nitro derivatives of anthraflavone, new naphthaline derivatives, and ferrocyanide of tetramethylammonium).—The independent formation-law of continued fractions, by M. Günther.—The development of the Euler Algorithmus, by M. Klug.—Researches on the separation of aqueous vapour in plants, by M. Eder. He first examines the external surfaces of plants as regards permeability for aqueous vapour; then the evaporation through leafless branches; and thirdly, the behaviour, as regards evaporation, of those parts of plants that are richer in water. He then describes experiments on transpiration of leafy branches and rooted plants under various conditions of moisture, light, motion of air, &c.—On the action of glycerine on starch at high temperatures, by M. Zulkowsky.—On the heat phenomena which occur on solution of ammonia in water, and their utilisation in employment of this salt for cold mixtures, by M. Tollinger.—On hypertrophic thickening in the interior of the aorta, by M. Schnopfhagen.—On Malfatti's problem, and the construction and generalisation by Steiner, by M. Mertens.—On Cinchonin, by M. Weidel.—On the heat-equilibrium of gases acted on by external forces; on the heat-conduction of gases; and on integration of partial differential equations of the first order, by M. Boltzmann.—Observations (meteorological and magnetic) at Vienna Observatory, in July to September.

Oct. 21.—An experiment towards explaining terrestrial magnetism, by M. Benedict.—Involutions of the chords in cissoids, by M. Jahradnik.—Researches on the colouring matters of bile, part v., On the action of bromine on bilirubin, by M. Maly. He shows that the molecule of bilirubin is twice as large as has hitherto been supposed.—On the double tangents of curves of the fourth order with three double points, by M. Durége.—Researches on the nature of the salmon (*Salmo Schiffermülleri*, Bloch) found in the lakes of Salzkammergut, Salzburg, and Berchtesgaden, by M. Fitzinger.—On occurrence and biology of Laboulbeniaceæ, by M. Peyritsch.

Oct. 28.—On development of the elements of Crustacea, by M. Hoeber.—Report on a journey in the western part of the Balkan and neighbouring regions, by M. Toula.—On a new condensation-product of gallic acid, by M Oser.—On the green colouring matter of *Bonellia viridis*, by M. Schenk.

Geological Society, Nov. 16.—The discovery of lake dwellings in the peat-bogs near Laibach, by Ch. Deschmann. These were discovered accidentally on the occasion of a road ditch being opened, and were afterwards systematically explored for the Laibach Museum. The extent of the lake-dwellings hitherto uncovered amounts to about 600 square fathoms. They cover an area of about 13 fathoms in breadth, extending parallel to the border of the ancient lake. The piles, some thousands in number, are rammed into the clay which forms the bottom of the peat-bog, their broken ends projecting 1 or 2 feet above the clay. Above the latter lies a deposit 5–6 inches thick, containing chiefly the remains of human industry, together with bones of various animals. This again is covered by the peat to a thickness of 5–6 feet. The lake-dwellings near Laibach are of special interest on account of the great abundance of bones and harts-horn, most of them showing signs of workmanship. The remains of stag alone that were found are supposed to belong to 200 different individuals; and besides various remains of ox, buffalo, hog, wild boar, goat, sheep, bear, badger, beaver, more rarely of wolf and lynx, &c., were discovered.—On the volcanoes of the Isle of Réunion (Bourbon), by Dr. R. Drasche. The author proved that the eruptive action since the first outbursts has proceeded continually from west to east. The oldest lava streams have an acid (strachytic) character; the later, up to the present day, are basaltic.—A fossil land-turtle from the Vienna basin, by G. Haberlandt. It was found in the later Tertiary, in a quarry near Kalksburg, and is the first land-turtle ever discovered in Austrian Niogene deposits, whilst sea and river turtles occur frequently therein. The fossil was named *Trionix precedens*.—M. Zugmaier showed an *Inoceramus* found in the Vienna sandstone near Klosterneuburg, a very important discovery in reference to the geology of the Alps, regarded as forming another proof of the justness of the views always maintained by the Austrian geologists, that the sandstone-strata bordering the northern part of the Alps belong chiefly to the Cretaceous period.—M. Paul gave a report of the results obtained by him in the course of last summer concerning the Karpathian Sandstone in Silesia, Hungary, and the Bukovina, that forms a direct continuation of the Alpine Vienna Sandstone just mentioned. He is convinced that the so-called Ropianka group of these sandstones, which contains the petroleum, belongs also to the Cretaceous formation.—M. Vacek exhibited an interesting fragment of a jaw-bone from a very small and probably young *Mastodon longirostris*, found in the Belvedere strata near Vienna. It had been presented to the Geological Institution by Lieut. Tihu.

WELLINGTON, N.Z.

Philosophical Society, Aug. 7.—Address by the President.—Dr. W. Z. Buller, C.M.G., gives a narrative of the progress of the scientific societies in New Zealand, and the various works which have been written on the natural history of the colony, and reviews the work done by the Society during the past year, as published in vol. vii. of the "Transactions" of the New Zealand Institute:—"From year to year the scientific work of the New Zealand Institute has kept pace with the rapid progress of the colony, and the last volume of 'Transactions' (No. vii.) is in every way worthy of its predecessors, both as to bulk and quality. On a cursory perusal it is evident that our Society has done its fair share of work during the year, no less than twenty-four of the papers selected by the governors as worthy of publication having emanated from our members. As most of you are aware, our vice-president, Mr. Travers, is one of the most industrious of our working members, and the present volume contains a lengthy contribution from him, entitled 'Notes on Dr. Haast's supposed Pleistocene Glaciation of New Zealand.' The author dissents entirely from the learned doctor's views, as propounded in his report to the Provincial Government of Canterbury in 1864, and since repeated; and following up his former article on 'The Extinct Glaciers of the South Island,' he has now placed before us an able exposition of his own views on this subject. Another important paper read before the Society during the past year is that by Dr. Hector, on Whales; and the excellent plates which accompany it, from photographs by Mr. Travers, add much to the interest of the article. It contains a full description of *Neobalæna marginata*, founded on a specimen which was captured among a large school of black-fish at Stewart's Island, and forwarded to the Colonial Museum by Mr. Charles Traill; also of the 'sulphur-bottom' (*Physalus australis*), the skeleton of which is now in the Wellington Botanic Gardens; and of that interesting form of zyphoid whale known as *Berardius hectori* from a specimen cast ashore in Lyall Bay in January last. It is to be hoped that Dr. Hector will be able to carry out his intention of publishing while in England a monograph of the Cetacea inhabiting the Southern seas, for which, as he informs me, he has collected and taken home ample material. There is probably no other section of Zoology in which a contribution of this sort would be more acceptable to the *savans* of Europe, owing to the present neglected state of its literature and the confusion of nomenclature in which many of the species are involved. There is another article from the same pen, on New Zealand Ichthyology, which contains descriptions of no less than sixteen new species of fishes, all taken recently on our coast, thus proving that this field of investigation is far from being exhausted. In the section Botany, the first article is a paper read by Mr. Buchanan in November last, on the flowering plants and ferns of the Chatham Islands, the materials being drawn from the collection in the herbarium of the Colonial Museum, nearly the whole of which was made by Mr. Henry Travers during his two expeditions to those islands in 1866 and 1871. The article throughout bears testimony to Mr. Buchanan's usual care and accuracy, and the illustrations, five in number, are very beautifully executed. That of the so-called Chatham Island Lily (*Myosotidium nobile*), a handsome plant, with large glossy leaves and clusters of blue flowers, which I was fortunate enough to discover during a visit to the Chathams just twenty years ago, is especially noticeable. Our late president, Dr. Knight, resuming a subject in which he has already

made several important contributions to science, presents us with a valuable paper on New Zealand lichens, and with another containing descriptions of some new species of Gymnostomum, all the carefully drawn illustrations being from the author's own pencil. The papers on chemistry have emanated, as usual, from Mr. Skey, the analyst to the Geological Survey, the value of whose work in this department of science has already been brought prominently before you by a former occupant of this chair. I will not detain you longer, as there are several papers to be read; but I would just point out that the eminently practical treatise by Mr. Lemon, on duplex telegraphy, and the suggestive paper by Mr. Mackay, on the hot winds of Canterbury, show that other subjects have been discussed, and that the attention of our Society has not been confined to any particular branch of scientific inquiry; that, on the contrary, it has during the past year kept in view the avowed object of its existence, viz. 'the development of the physical character of the New Zealand group: its natural history, resources, and capabilities.'" —A paper was read from the Ven. Archdeacon Stock, containing remarks upon a large bat that had been seen by him in 1854, which he believed to be a new variety. Mr. Kirk stated that he had seen a large bat at the Clarence River, but he had been unable to distinguish it from *Scotophilus tuberculatus*.—The President read a paper entitled "Notes on *Gerygone flaviventris*." The paper contained extracts from "The Birds of New Zealand," and observations in reply to a paper from Mr. Justice Gillies, in last year's volume of "Transactions."—A paper entitled "Remarks on Dr. Finsch's Paper on Ornithology in vol. vii. of 'Transactions of the New Zealand Institute,'" was also read by the President. The paper contained criticisms on Dr. Finsch's views respecting classification, as propounded in a paper read before the Otago Institute. A discussion ensued, in which the author of the paper and Messrs. Kirk and Graham took part, on the question, "What constitutes a species?" The President contended for the specific value of *Apteryx mantelli* of the North Island, on the ground that it was readily distinguishable from the other bird, and that the variation was *constant*; while Prof. Kirk agreed with Dr. Finsch, who proposes to call it *Apteryx australis* var. *mantelli*, considering that the bird discovered in the North Island is merely a variety of the species in the South—*Apteryx australis*—the slight difference between them being insufficient to warrant their separation.

Aug. 21.—J. Carruthers, C.E., Engineer-in-chief for the Colony, On volcanic action regarded as due to the retardation of the earth's rotation.—Mr. J. C. Crawford, F.G.S., On the igneous rocks of Wellington. The paper pointed out in a lucid manner the course that past explorations had taken in regard to the igneous rocks of this province, and indicated the direction that future explorations should take.

California

Academy of Sciences, Sept. 20.—Dr. Blake made some remarks on the old Sierra glacier in the neighbourhood of Johnson's Pass, at the head of the south fork of the American river. The pass forms a low gap in the mountains about 7,500 feet above the sea, and extends about a mile and a half from north to south, the summit of the mountain being nearly level for that distance. To the east of the pass and 1,000 feet below is Lake Valley, fifty miles long from north to south, and twenty miles broad in some parts; this valley contains the basin of Lake Tahoe, which has a depth of 1,600 feet. The topography of the pass is such that no moraine matter would reach the head of it until the basin of Lake Valley was filled by ice above the level of the pass, or by a glacier 1,000 feet thick, nor during the decline of the cold would any extensive glacier form there after the level of the ice in Lake Valley had fallen below the level of the pass. Such being the case, we have at the head of the American valley the results of glacial action during the middle of the glacial epoch, or at least during the time the glacier in Lake Valley was increasing from a thickness of 1,000 feet to a thickness of 1,600 or 1,700, and also whilst it was diminishing from its maximum depth down to the level of the pass. The indications are that during this period a very high summer temperature must have prevailed, alternating with the greater cold of winter. The considerations on which this conclusion is founded are, first, the fact that no permanent ice-covering could have existed at the head of the pass at the time the Lake Valley glacier had already reached a thickness of 1,000 feet, otherwise moraine matter could not have been deposited in the vast moraines now found at the head of the pass. Notwithstanding the great winter cold and the increased snowfall, at least far on in the glacial epoch, the heat of the summers must have been more than sufficient to thaw the annual snowfall at this elevation when its thickness was not increased by inflowing glaciers. Another fact indicating the existence of a high summer temperature is the comparatively small extension of the glacier down the valley of the American river. During the height of the glacial epoch the thickness of the glacier at the head of the valley must have been 600 or 700 feet above the level of the pass, and yet the bulk of the moraine matter it transported has been deposited as terminal and lateral moraines within eight miles of the summit. As the valley in this distance has only fallen about 800 feet the melting of the ice must have been much more rapid than it would be with our present summer temperature.—Mr. Lowry, of the U.S. Coast Survey, read a paper on a modification of what is known as the three-point problem in hydrographical surveying, by which a position would be determined by means of two points the distance of which was known, and a point on the shore of undetermined distance.

BOOKS AND PAMPHLETS RECEIVED

British.—The Universe: F. A. Pouchet, M.D. (Blackie).—Time and Time Tellers: J. W. Benson (Hardwicke).—Official Guide to the Manchester Aquarium: W. Saville Kent.—Report of the First Annual Conference of the Cryptogamic Society of Scotland.—Memorials of Harvey: J. H. Aveling, M.D. (Churchill).—Tales and Traditions of the Eskimo: Dr. Henry Rink (Blackwood).—The Sea: Jules Michelet (Nelson).—The Arctic World (Nelson).—Map of India indicating the probable Route of the Prince of Wales (Stanford).—The Cruise of the *Dwarf*: Captain Bax (Murray).—Solid Geometry. Vol. i.: P. Frost (Macmillan).—Water Analysis: J. D. Macdonald (Churchill).—Physics of the Ether: S. Tolver Preston (Spon).—Proceedings of the Geological Association. Vol. iv. No. 4.—Quarterly Journal of the Geological Society. No. 124.—Quarterly Journal of the Meteorological Society No. 16.

American.—Abstract of Results on a Study of the Genera Geomys and Thomomys: Dr. Elliott Coues, U.S. Army.—Elements of Infinitesimal Calculus: James G. Clark (Lockwood).—On a New Method of obtaining the Differentials of Functions: J. Minot Rice and W. Woolsey Johnson (New York, Van Nostrand).—Theory of the Moon's Motion: J. N. Stockwell, M.A. (Boston, Lippincott).—Systematic Catalogue of the Vertebrate of the Eocene of New Mexico: E. D. Cope, A.M. (Washington).—Address of the Ex-President Joseph Lovering before the American Association, Hartford.—A Review of the Fossil Flora of North America: Leo Lesqueureux (Washington).—Monthly Report of the Department of Agriculture, U.S.—Memoirs of the American Association for the Advancement of Science, 1875 (Salem).—The Spider of the United States: N. M. Heutz, M.D. (Boston).

Foreign.—Jahresberichte der Commission zur Wissenschaftlichten Untersuchung der deutschen Meere in Kiel, 1872-3.—Memoire de la Société de Physique et d'Histoire Naturelle de Genève.—Classification de 40 Savons Végétaux: M. Bernardin (Gand, Annoot-Braeckman).—Ueber die Störungen der Grossen Planeten insbesondere des Jupiter: P. A. Hansen (Leipzig, S. Hirzel).

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