THURSDAY, MARCH 7, 1878

REPRESENTATION OF SCIENCE AT THE PARIS EXHIBITION

WE are glad to know that the interest shown in the Loan Collection of Scientific Apparatus at South Kensington and the benefit to the nation at large to be derived from such displays have not been lost upon the organisers of the French part of the forthcoming Exhibition.

Among the most energetic and most enlightened of these organisers we must count M. Bardoux himself, the new Minister of Public Instruction, under whose auspices for the first time a well-developed scientific side will form part of an International Exhibition. Culture will be added to industry. Research will have its place, side by side with the applications of science.

The attempts to give prominence to this side of the exhibition on the part of the French are as remarkable as the complete neglect of everything touching science by our own Commission. For them apparently science does not exist, except the science that pays, in the shape of large engines and looms, fine stuffs, machine-made jewellery, and the like. England will have its Burlington Arcade, but not its Burlington House. We give the Commission credit for having "worked" the commercial world well; we only complain that the possibility of there being anything worth exhibiting from the scientific point of view never seems to have occurred to them.

The antithesis we have drawn between the Burlington Arcade and Burlington House well represents the great point of the forthcoming Exhibition. There will be a gigantic shop on the Champ de Mars, there will be a gigantic temple devoted to the pure sciences and to pure art in the Trocadero. The river will separate the source from the application; instruction in science and art from commerce and industry.

Hence it is that M. Bardoux, having already organised on a large scale the representation of the fine arts and public instruction, is now organising what is to be called the "scientific display." This part of the work, important though it be, will be rendered very simple to the Minister, as the matter will be left almost entirely in the hands of the men of science themselves, including, of course, those men of science who direct important branches of the public service as well as individual investigators.

Thus each Government department will show the way in which its scientific work is done. The three new Government observatories in Paris will exhibit either results or methods. There will be a complete collection illustrating the various scientific missions which France has undertaken during the present century, and all the publications, scientific, historic, and artistic, which have been published by the state will be there for all the world to see.

Not only, therefore, will there be a true Loan Collection of Scientific Apparatus, but the example set by the South Kensington Conferences will also be followed. The enormous building in the Trocadero contains a lecture theatre capable of holding upwards of 4,000 people. This will be used for lectures in scientific and kindred subjects, for which arrangements are now being made. It is impossible that the Trocadero buildings can be ready by May 1, so there will be ample time for these arrangements and for the others, to which we may briefly allude.

The French Association for the Advancement of Science will conduct a large number of scientific experiments on a great scale, and a large number of exhibitors will take advantage of the meeting of that association to exhibit experiments relating to their special pursuits.

Every facility will also be given to scientific societies for summoning to a special congress those prosecuting the same line of research. The number of these useful assemblies is increasing daily. It would occupy too much space to give a list of all the societies which will hold such meetings, but many circulars illustrating the development of this sectional movement have already been printed.

Lecture-rooms will be furnished *gratis*, lectures will be advertised on a large scale, and, as far as possible, Government apparatus will be at the disposal of inventors for conducting the experiments required to illustrate their lectures. What has been done at the provisional Ethnographical Museum, to which we have already referred, may be considered as a fair specimen of what will be done on a larger scale at the Trocadero Palace and other suitable buildings.

It may be said that nothing will be spared to make the Exhibition useful to science and intelligible in its scientific aspects for the largest number of people.

Surely England might have been able to contribute something of interest to this most interesting side of the Exhibition? We surely must, after all, be merely a nation of shopkepeers seeing that our Royal Commissioners have doubted our capabilities in any other direction!

METROLOGY

Inductive Metrology; or, The Recovery of Ancient Measures from the Monuments. By W. M. Flinders Petrie. (London: Saunders, 1877.)

THIS work has a somewhat ambitious title, but it may fairly claim to be written upon a scientific basis, and it bears evidence of much study and laborious research. It is an attempt to carry out generally the method originated by Sir Isaac Newton, in his well-known Dissertation on Cubits, of determining the length of the ancient Egyptian cubit from some of the measured dimensions of the great pyramid. By a similar process the author has endeavoured to determine the ancient standards of linear measure in various countries from the measurements of remaining monuments. No allusions are made to weights and volumes, but only to linear quantities, as these alone are shown by the architectural remains.

In accordance with Whewell's definition of "induction," Mr. Petrie says that "inductive metrology ascertains the 'general truths' of the units of measure in use from the 'particular facts' of those multiples of measures which ancient remains preserve to us." He assumes that in the construction of all such works, if a measure existed, it would be used, and that whole numbers would be used in preference to fractions and round numbers in preference to uneven ones, merely for convenience in the work. We know

this to have been the case with regard to the various dimensions of the tabernacle constructed by Moses, of Solomon's Temple, and the later temple as described by Ezekiel, The length of the Royal Egyptian Cubit was determined by Sir Isaac Newton, from Greaves's measurements in the great pyramid, to have been between 20·62 and 20·78 English inches. Amongst these measurements the so-called King's Chamber was found to be 20 of such cubits in length, and 10 in breadth. The passages were 2 cubits broad. The principal gallery was 4 cubits broad, with a middle way of polished marble 2 cubits broad, and a raised bench on each side 1 cubit broad and 1 cubit high. In Newton's time, no direct evidence of the true length of the ancient Egyptian cubit had been brought to light. We now know from several ancient standard cubit rods since discovered, that the mean length of the royal Egyptian cubit was equal to 20·67 English inches. In this essay Mr. Petrie states that all the deduced units of measure were in every instance found in a similar way independently of any known standard, and have not been obtained by trying whether the measures would fit any known unit. As to standards of measure, they are only employed by the author to subject assumptions to proof, where such can be obtained.

The least number of measurements that suffice to give a unit with tolerable certainty is assumed to be three. Long lengths were found of little value in obtaining the unit, and moderately short lengths from about 2 to 20 feet are stated to be the best. After showing the several modes of ascertaining as nearly as may be the unit of measure from a given number of actual measurements, that is to say, the ratio between them, the process adopted has been to group together those units of any one country and age that seemed to be identical, or derived from and related to one another, and thence to deduce the mean unit. In every case the probable error has been computed and stated. This probable error is assumed to arise from original errors in planning and executing the work, and not in the more recent measurements, as with reasonable caution such errors may be tolerably avoided.

The extent of the work undertaken by the author may be judged of from the statement that more than 600 buildings and other remains have been examined and their constructors' units deduced from the mean results of over 4,000 measurements. A considerable number of them were made by the author, many being of objects in the British Museum. To insure correctness the English measure used by him was verified as to its accuracy at the Standards' Office.

The first series of groups relate to Egyptian architectural remains, generally from the fourth dynasty to the Roman period. The deduced units of the measurements of 101 monuments are stated in English inches and decimal parts of an inch, and the number of independent lengths from which each such unit was obtained is also specified. The deduced units of one of these groups, consisting of twenty-eight different monuments vary only from 20·42 to 20·84 inches, the mean being 20·64, thus agreeing very nearly with the ascertained length of the royal cubit = 20·67 inches. From the remaining monuments the author deduces other units several of which are multiples of the digit, the twenty-eighth part of the royal cubit. The common cubit, or cubit of a man, equal to 18·24 inches, has not yet been found inductively from remaining monuments.

The next series of monuments examined are those of Babylonia and Assyria, Persia and Syria. These countries are classed together as being intermixed in the style of their art and the nature of their architectural remains. The results of the measurements of 102 monuments are given, with various deduced units of measure. The Persian monuments are chiefly those of Persepolis. It may be more interesting to refer to the Syrian monuments as they include those of Judæa and Palestine, and of Moab. As an instance, the mean unit of 25·01 inches (varying from 24·57 to 25·55 inches) is found from six monuments, four of which are at Jerusalem. This is taken to be the mean length of the sacred Jewish cubit. It is to be observed that in his "Dissertation on Cubits," Sir Isaac Newton arrived at the conclusion that the length of this cubit was 24·83 inches. It is now generally considered to have been a little more than 25 inches, and it is supposed to have been the cubit measure taken from Chaldæa by the ancestors of the Jews, and to have continued in use by their posterity in Egypt and Palestine.

The countries that follow are Asia Minor and Greece. The first of these affords eleven different units from eighty-four measured monuments. Eight of these units are known to have been used by nations that ruled there, and the other three are connected with the units of adjacent countries. From Greece and its colony Sicily the results of the measurements of forty-nine objects are given, including Pelasgic and later monuments.

Italy, Africa, and Sardinia are next classed together. The results of the measurements of seventy-seven monuments are shown under the head of Italy, including Roman remains in Britain, Africa, and other countries probably constructed with Italian units of measure.

The mediæval remains in Ireland and England conclude the several classed groups of monuments measured. The measurements of twenty-nine round towers and churches connected with them in Ireland give two deduced units. Out of eighty-one measured old English remains the inch and foot were found to be the units in sixteen cases only, the mean inch unit being equal to 0·9998 of our present standard inch, showing that on the average the inch measure has not varied appreciably for centuries. Several other units of other countries are deduced from the remaining monuments.

The last series of measurements are those of rude stone remains and earthworks in various countries. At first sight it does not appear possible that such objects should lead to units of measure being derived from them; but the results show, in the author's opinion, that the more regularly constructed remains were made by a measure-using people.

After mentioning the results of measurements partly of the dimensions and partly of the relative positions of various ancient stone remains and earthworks in this country and in France, the results of about seventy measurements of the dimensions of ancient North American earthworks are stated to lead to a unit varying from 12·50 to 12·72 inches, with a mean of 12·6 inches, divided duodecimally. The mean unit of twelve Mexican measurements was 10·65 inches.

The author claims, as the chief results of his inductive examination, to have determined from the monuments the true values of the Sacred Hebrew or Royal Persian cubit, the Royal Egyptian cubit, the Egyptian digit, the Assyrian cubit, the ancient Greek foot, the Olympic foot, the Drusian foot, the Plinian foot, and the Pythic foot, together with the probable errors of these determinations.

He claims also to have found that the principal standard units of length were in more extended use than was previously known, and to have indicated the countries in which they were used. And also that he has brought to light many other units of length of which the knowledge had been previously lost.

It is not probable, however, that all persons who have given mature consideration to the contents of the work will concur in the stated results or be altogether satisfied with some of the mean units obtained. In every case a unit deduced from the actual measurements is stated, and not the measurements themselves. But a large proportion of these deduced units are not whole numbers of the mean unit obtained from them. Thus, taking one of the instances most favourable to the author's views, out of twenty-eight Egyptian monuments, from which the mean length of the royal Egyptian cubit is obtained, twelve only of the deduced units are whole numbers, the others being various fractions of the mean unit, and many of them, such as $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{2}{5}$, $\frac{5}{8}$, $\frac{1}{50}$, $\frac{4}{50}$ are fractions not marked upon any of the extant standard cubit rods, which are divided only into seven palms and twenty-eight digits.

The essay will be read with much interest and advantage by those persons who have given their attention to metrological science. It appears to be a valuable contribution to historical and ethnological literature, and to be a ground-work for further researches on the subject.

WOLF'S HISTORY OF ASTRONOMY

II.

Geschichte der Astronomie. Von Rudolf Wolf. (München : R. Oldenbourg, 1877.)

IN our former notice of this valuable addition to astronomical literature (NATURE, vol. xvii. p. 259) reference was made to the great amount of information which the author has compressed within a moderate space in the third and last section of his work which treats of "the newer astronomy." We propose here to take a brief survey of the principal contents of this portion of the volume to assist the reader's appreciation of the work.

The third section is subdivided into four chapters—9—12. The first commences, as before stated, with Sir Isaac Newton's discovery of the principle of universal gravitation, the publication of the "Principia," and the first application of the new theory to the orbits of comets by Halley, whose meritorious connection with the publication of Newton's immortal work is well known. This is followed by some account of the foundation of the Observatories of Greenwich and Paris, and soon afterwards of those of Berlin and Copenhagen, whereby so great an impetus was given to practical astronomy; of Richer's expedition to Cayenne for the determination of the solar parallax, from corresponding observations of the planet Mars, and the first ideas as to the applicability of transits of Venus for the solution of the same problem. The labours of the earlier workers in the Newtonian theory—of Bernoulli, Euler, Clairault, and others, are particularised; also Bradley's great discoveries of the aberration of light and the nutation of the earth's axis, together with his work in the field of observation, with the similar work of Tobias Mayer and Lacaille. Further on the same chapter treats of the labours of Lagrange, Laplace, Gauss, and others in theory, and of Herschel, Piazzi, Bessel, Struve, and others, in the practice of astronomy. We have some account of the "Theoria Motus," the "Fundamenta Astronomiæ," amongst classical works, and of progress made in the solar, lunar, and planetary theories, and formation of tables and ephemerides. Amongst the remaining varied contents of this chapter there are notices of the discovery of Neptune, stellar parallax, the connection between solar spots and the earth's magnetism, the application of photography to astronomical purposes, and the introduction of the spectroscope.

Chapter 10 is devoted to astronomical instruments and their uses, after some remarks upon methods of calculation introduced in modern practice. There are brief notices of instruments in their various forms, from the complicated heliometer to the simpler appliances in the hands of observers, with descriptions of many of the more important purposes for which they have been brought into use. The chapter concludes with a reference to Lacaille's memorable expedition to the Cape of Good Hope and the expeditions undertaken on occasion of the transits of Venus in 1761 and 1769.

Chapter 11, on "The Structure of the Heavens," is as varied in its contents, amongst which we may note: The periodicity of sun-spots, and the new views upon the physical constitution of the sun; the ring of small planets; the zodiacal light; the meteor-streams and their connection with comets; the physical condition of comets; the distribution of the stars; the Milky Way; solar motion in space; variable and double stars, and binary systems; stellar spectra, star clusters, and nebulæ.

In Chapter 12 we have an account of the principal modern literature, periodical and otherwise, bearing upon astronomical science in its various branches. There are notices of the works of Weidler, Lalande, Bailly, Montucla, Delambre, Littrow, Madler, and others, and of such works as the *Acta Eruditorum*, the *Monatliche Correspondenz* and the *Astronomische Nachrichten*.

It should be understood that the one chief advantage which the student is likely to derive from Prof. Rudolf Wolf's "History of Astronomy" will be a knowledge of the authors, methods, &c., with which it may be necessary for him to become acquainted in turning his attentisn to any particular department of astronomy, an advantage that may not be immediately apparent from the title of the work. Prof. Wolf does not enter into any amount of detail, nor indeed would it have been practicable within the limits of this volume. But as affording in comparatively brief space an accurate idea of the gradual progress and actual state of astronomical science and a valuable guide to any one entering upon its study, this book may be confidently recommended. J. R. HIND

[1] Continued from p. 259.

OUR BOOK SHELF

The Spectroscope and its Work. By Richard A. Proctor. Society for Promoting Christian Knowledge. (London : 1877.)

IN a little work of 127 pp. Mr. Proctor has clearly and logically explained the principles of the science of spectroscopy, and has given a sketch of the main results of spectroscopic research into the nature of the sun, stars, and nebulæ.

One of the features of this book is, we think, the logical manner in which the principles of spectroscopic analysis are developed from the facts gained by observation and experiment ; the steps of the various reasonings are succinctly but clearly stated ; this is a point of much importance. In too many so-called scientific text-books there is a loose and illogical method of connecting facts, and conclusions drawn from these facts ; by the perusal of such books the general reader is either strengthened in his prejudged conviction that science teaching is of little or no value as a mental exercise, or he is taught, often almost unconsciously, to believe that the generalisations of science and the facts of science rest upon exactly the same evidence. Another feature in Mr. Proctor's little book is the adoption, necessarily to but a limited extent, of the method of historically developing the facts of the science of which he treats. The leading steps in the history of the most important advances in spectroscopy are traced, frequently by quotation from the classical memoirs of the great workers in the science.

The book is divided into eight chapters, headed respectively "Analysis of Light," "Dark Spaces in the Spectrum," "Various Order of Spectra," "Interpretation of Solar Spectrum," "Solar Prominences, &c.," "Spectra of Stars, &c.," "Atmospheric Lines in Solar Spectrum," "Measuring Motions of Recession and Approach."

Whether as an introduction to the fuller study of spectroscopic analysis, or as a work from which the general reader may gain a clear, and, so far as it goes, complete view of the science, Mr. Proctor's work is deserving of the warmest recommendation.

M. M. PATTISON MUIR

The Great Thirst Land ; a Ride through Natal, Orange Free State, Transvaal, and Kalahari Desert. By Parker Gillmore. (London : Cassell, Petter, and Galpin.)

CAPTAIN GILLMORE'S work is disappointing. The title suggests Major Butler's "Great Lone Land," but the result of a comparison of the two works would not be very favourable to Capt. Gillmore's. He has nothing new to tell the geographer, and many of the hunting stories are comparatively tame. The work is unnecessarily large, and could with advantage be compressed to half its present size. Still there are a number of observations on the Boers and the natives which will interest many, and there are a few good lion stories. The book is handsomely got up.

LETTERS TO THE EDITOR

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

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Strychnia and its Antidote

THE following circumstance I think worth noticing. Wanting to banish some mice from a pantry, I placed on the floor at night a slice of bread spread over with butter in which I had mixed a threepenny packet of "Battle's vermin killer," which contains about a grain of strychnia along with flour and prussian blue. The following morning I was roused by a servant telling me that a favourite skye terrier was lying dead. I found that the mice had dragged the slice of bread underneath the locked door and that the dog had thus got at it and eaten part equal to about one-sixth of a grain of strychnia ; it lay on its side perfectly rigid ; an occasional tetanic spasm showed that life was not quite extinct. Having notes of the experiments made by direction of the British Medical Association last year, on the antagonism of medicines, and wherein it was conclusively proved that a fatal dose of strychnia could be neutralised by a fatal dose of chloral hydrate, and that the minimum fatal dose of the latter for a rabbit was twenty-one grains, I at once injected under the dog's skin forty-five grains of the chloral in solution, my dog being about twice the weight of a rabbit. In a quarter of an hour fancying the dog was dead, as the spasms had ceased and it lay apparently lifeless, I moved it with my foot, when it at once struggled to its feet and shortly after staggered to its usual corner by the parlour fire ; it took some milk, and except for being quieter than usual seemed nothing the worse for the ordeal it had passed through.

That the fatal effects of a poisonous dose of strychnia was thus counteracted so successfully by what I should say was a poisonous dose of chloral, given hypodermically, is an interesting fact verifying the experiments I alluded to. Without such experiments on the lower animals, a medical man might often be found standing by helpless to aid his fellow-man under similar effects of poison.

Sudbury, Suffolk, February 27 J. SINCLAIR HOLDEN

Age of the Sun in Relation to Evolution

I THINK I may be permitted to point out that Dr. Croll has missed what I had intended to be the main feature of my criticism of his article on the "Age of the Sun in Relation to Evolution." I should therefore wish to reiterate that, in his theory, he takes no account of the proper motions of the stars in space. If it be true that suns or stars have been formed by the collision of bodies possessed of great energy, proper motion can be none other than the unused and unconverted energy of the original components. Supposing the forces, before impact, to be equal and opposite in direction, there can be no misunderstanding that the result will be the *entire* convertion of the "motion of translation to molecular motion," *i.e.*, heat ; but this, according to the law of chances, must be of exceedingly rare occurrence. Yet, from our knowledge of the motions of the stars in space, this, or something very like this, has invariably occurred. Surely here is a *reductio ad absurdum*. In conclusion I will merely state that I have never yet claimed to have suggested a theory reconciling the age of the sun with prevailing opinions in geological science or with the hypothesis of evolution. Having felt the difficulty, I have endeavoured in some measure to stretch the interval wherein these may have had time to effect their changes, but I have not claimed to have succeeded to the desired extent. I am not, therefore, interested in replying to the former part of Dr. Croll's letter, and indeed, with certain minor reservations, have no hesitation in subscribing to it. JOHN J. PLUMMER

Orwell Dene, Nacton, February 28

The Zoological Station at Naples

PERMIT me to correct some statements made in NATURE, vol. xvii. p. 329. The small steam launch was given to the Zoological Station by the Berlin Academy of Science, in exchange for a working table in the laboratory, which is to be placed at the disposal of the Academy for ten years. The Prussian government subscribed 300*l.* towards the expenses of the launch, which was built by Messrs. J. Thornycroft, Church Wharf, Chiswick, and has proved an excellent little craft.

As to the publications of the Zoological station, the *Prodromus Faunæ Mediterraneæ* will be a compendium of all the species hitherto observed in the Mediterranean, and recorded in scientific works. Its publication is mainly intended to facilitate the nomenclature of the chief work, the "Fauna and Flora of the Gulf of Naples and the Neighbouring Seas," which is to appear in monographs. The *Prodromus* has been undertaken by Prof. T. Victor Carus, whose great knowledge both of zoological literature and classification will answer its exactitude and completeness.

The first monograph to be published is not on the *Elanophoræ*,

but on the *Ctenophoræ*, a family well known to all students of pelagic animals. ANTON DOHRN

Naples, February 28

Faraday's "Experimental Researches"

IF your readers will compare Mr. Quaritch's letter in last week's NATURE with his advertisement of the two preceding weeks, they will see that it bears its condemnation on its own face. No words of mine can make it plainer than his do, that a *reprint* of an obsolete and valuable book was offered to the public as something not stated to be a reprint. Had that advertisement stated that the work was a "facsimile reprint," there could have been no ground either for complaint or for an indignation for which no apology is needed.

University College, Bristol SILVANUS P. THOMPSON

Mimicry in Birds

ON the evening of the 24th inst. my attention was attracted by an interesting example of mimicry in the case of the starling. The first thing which attracted my attention was hearing the cry of a blackbird in distress, and on looking round, the only bird to be seen was a solitary starling, which, when I first observed it, was uttering its own note; but almost immediately thereafter it began to whistle loudly in imitation of the blackbird. After this, for the space of about half an hour, it kept up a constant succession of notes in mimicry of the chaffinch and sparrow, always, however, using its own note for the space of about half a minute between each change. I may add that it did not seem to have any particular order in which it repeated the various notes.

A gentleman in this neighbourhood tells me that last year he observed a similar occurrence in his garden; but this, so far as I can learn, is the only other instance of similar mimicry in this quarter. Perhaps some of your readers may be able to inform me if it it is of common occurrence elsewhere.

Edinburgh, February 26 J. STUART THOMSON

Great Waterfalls

SEEING Mr. Guillemard's inquiry (vol. xvii. p. 221), I refer him for accounts of the Falls of Tequendama, which I visited in 1851, to "Viajes Cientificos a los Andes Ecuatoriales, &c.," por M. Boussingault, traducidas por J. Acosta; Paris, 1849, and "New Granada: Twenty Months in the Andes," by Prof. Isaac F. Hotton. (New York: Harper and Brothers, 1857.)

New York, February THOS. BLAND

SEVERAL NEW APPLICATIONS OF SCIENCE INTRODUCED INTO WAR

ON Saturday last, the Speaker of the House of Commons and a large following of members, visited the Portsmouth Dockyards, mainly for the purpose of witnessing some torpedo warfare; the *Inflexible* was also inspected. Near the starboard side of the ship, one of the sheds had been converted into a temporary lecture-room, and provided with numerous diagrams, a model of the ship, and a full-sized skeleton model of the 80-ton gun, 26 feet long, 6 feet broad at the breach, and having a calibre of 16 inches, with four of which it is intended to arm the turrets of the *Inflexible*. The diagrams were drawn on a scale of one-fourth of an inch, half an inch, and 6 inches (half-size) to the foot, and were designed with the object of enabling the visitors to draw a comparison between the structures of the *Dreadnought* and the *Inflexible*, and the respective thicknesses and disposition of their armour. As soon as the party had assembled around the drawings, Mr. W. B. Robinson, the Chief Constructor of the yard, stepped forward and delivered a brief illustrative lecture on the main points and differences of the two ships. He pointed out that while the length of the *Inflexible*—320 feet—was exactly the same as the *Dreadnought*, its beam—75 feet—was 11 feet 2 inches broader; that its volume of displacement was greater, its armour heavier, its turrets thicker, and its armament more formidable. While, however, the *Dreadnought* was armoured along the water-line, the citadel of the other ship, which was placed upon an armoured deck below, was the only protected portion of the *Inflexible* above the water. The arrangements of the turrets was also different; for whereas those of the smaller ship were placed along the middle line, the turrets of the larger were *échelonéd* to starboard and port in order that all the four guns might be trained upon an enemy either direct ahead or direct astern. The weather deck between the turrets had also been raised, so that the guns could be loaded from below without the necessity of depressing their muzzles. She was supplied with steam and hand pumps, and with Friedland's injectors, which would enable her to discharge 5,300 tons of water an hour. She had 133 water-tight compartments, and water would be admitted into the double bottom to reduce the rolling of the ship. Her torpedoes would be discharged from submerged ports in the bows instead of from above the water in the side, as in the *Thunderer*. The ventilating arrangements will be of the most perfect kind; for, as Mr. Robinson remarked, while in the other ships the fresh air is pumped into all parts, no means are adopted for assisting the vitiated atmosphere out of the ship. In the *Inflexible*, however, the ventilation comprises both supply and exhaust arrangements. The air is brought down into an air chamber, or cave of Æolus, in the central part of the citadel, and is driven thence by steam fans through large pipes, which pass under the armour deck and up into the structures above, and by means of branch pipes fitted with cocks every compartment in the ship can receive an abundant supply. By these cocks an officer can regulate his air supply in much the same way that a householder on shore can regulate his water supply. The vitiated air is sucked up through pipes with perforated ends into the funnels, and thence through the citadel into the open air. The *Inflexible* will be brig-rigged, but her masts will be unshipped before going into action. Her engines are of 8,000-horse power, and she is expected to attain a speed of 14 knots.

Runs of the 16-inch Whitehead torpedo were next made. One was fired from a steam pinnace as in actual warfare, its course, which was in a straight line for about 200 yards, being distinctly traceable by the exhaust air-bubbles which it threw up. The other was discharged from the surface of the water for the purpose of showing how readily it sank automatically to the required depth. The next novelty submitted was the steam pinnace, which, without having a single man on board, can do everything but stoke and keep its own fires alight. Its engines are worked and its movements are controlled wholly by electricity, the cable which supplies it with its mysterious power being unwound from winches as the pinnace sails on its mission, "And drags at each remove a lengthening chain." Its principal use is to drop and explode countermines in the neighbourhood of an enemy's mines, and by destroying them clear a harbour for the approach of the fleet. It performed its work to the amazement of the beholders on Saturday. The countermines were represented by a couple of barrels containing small charges of gun-cotton, and with these slung over the sides it took its departure from the boat containing the battery and dropped the casks at a distance of about 200 yards, igniting at the same time the fuses which blew the barrels into match-wood, and returned obediently, like a "thing of life," to the controlling hand after having accomplished its duty. Near at hand in the basin the torpedo nettings for protecting ships against the locomotive torpedo were exhibited on the sides of the *Actæon*, while the prow of the *Bloodhound*, gunboat, was armed with the trawl with which it is proposed to pick up sunken mines. The notes of the bugle were next heard as a summons to quarters and for the *Thunderer* to be cleared for action. In an

incredibly short space of time the stanchions and guard-rails were flung down, the water-tight doors closed, and the couple of Gatling guns dismounted from their carriages on the superstructure deck and hoisted up to the tops, whence they could each discharge 200 shots per minute upon hostile boats. Presently the process of loading the guns was gone through, in the fore turret by hydraulic power, and in the after turret by hand gear; the turrets were rotated and the guns run out, and the snapping of the tube fuses told the spectators that a furious action had commenced.

The party was next conveyed to the *Vernon*, torpedo school, where Capt. Arthur and Commander Wilson had still more surprising wonders in the art of warfare for them to witness. First of all, Commander Wilson delivered a hurried lecture on the mysteries of torpedo science, explaining the differences between offensive and defensive torpedo warfare, the nature of the several explosive substances used, and the methods of firing torpedoes—mechanically, by means of glass tubes of sulphuric acid, which explode on coming in contact with chloride of potash, or glass tubes filled with potassium, which causes explosion on mixing with the water, or, electrically, by means of detonation produced by fulminate of mercury. Commander Wilson also showed by means of a model in a tank the method of ascertaining when a ship is over a sunken torpedo by means of cross-bearings, and how the mine is fired as soon as the telescope which is following the movements of the ship completes the electrical circuit. As the model, however, did not sink with great alacrity in its mimic ocean, Commander Wilson explained that the torpedo did not profess to destroy a ship instantly, but only to knock a hole in the bottom about the size of a barn door. At the conclusion of the lecture the company again went on deck, and saw discs of dry and damp gun-cotton harmlessly consumed, and how a solid block of wood could be shivered by the same material when exploded with a detonator. Next, on looking over the bulwarks, they beheld a practical illustration of the boat's crew "creeping" for an enemy's torpedo, the process consisting in dragging for the mooring chains, and, when found, destroying them by a discharge of gun-cotton. They were also shown the manner of attack with star torpedoes, firing lines of counter mines by "bumping" the circuit closer, and, lastly, how attacking boats can be destroyed by grenades fired by fuses held in the hand. These beautiful experiments closed the day's programme.

We are glad that so large a body of our legislators were present, and we are sure they could not fail to be impressed with the importance of science in its bearing on war. In fact it has become clear that the more war we have, or are likely to have, the more is science needed; and it would indeed be a very short-sighted policy for Government to cut down the very moderate supplies allowed to science for the purpose of providing war expenditure. We hope that after what they saw on Saturday the members of the House of Commons will have a higher opinion of the national value of scientific research than to adopt any such course.

METEOROLOGICAL NOTES

TORNADO IN CHESTER COUNTY, PENN., U.S.—Mr. Richard Darlington, of Ercildoun Seminary, has published an account of a remarkable tornado which swept over this portion of the United States on Sunday, July 1, 1877. The tornado appears to have been first felt a little to westward of the boundary line between Chester and Lancaster Counties, and to have thence run a course of twenty-two miles, first in a direction E. 20° S., then E. 15° S., and lastly, E. 7° S., moving bodily onwards at rates of from five to fifteen miles an hour, the average progressive movement being twelve miles an hour. The destruction of trees, houses, and other property is estimated at about 40,000 dols., the destruction being most complete in those cases where the tornado moved across a valley. An uninterrupted roar, like that of thunder, accompanied it during its whole course, which is sufficiently accounted for by the inherent energy of the tempest itself and the havoc it wrought throughout its course, such as twisting thick oak-trunks in two, tearing up tall trees by the roots, and whirling them aloft, and blowing down buildings and scattering their contents in all directions. The breadth of the tornado varied from 100 to 300 feet, the average being 200 feet, though the *débris* was scattered to a greater distance on either side. It appears to have originated between a south-west and a north-west wind, where a large dark cloud seemed to form in the atmosphere, suspended from which was a whitish funnel-shaped cloud whirling round in a terrible manner. The air was thick with the objects which were whirled aloft, the movements of which closely resembled buzzards sailing round. The rotary movement was to the left, and the cone appeared to be a cloud of vapour nearly white, connected at the upper end with a smooth surface of cloud somewhat darker. The upper portion of the cone appeared to move in a straight line and at a uniform rate, while the tail or lower end frequently bent in different directions, as if swayed from its true course by the hills and valleys it crossed. No rain fell in its track, but hailstones of a large size and in great quantity fell at intervals along its north side. Trees in the northern half of the track were generally thrown down with their tops to the south, while those on the southern side were thrown to the north; but at certain points, such as at Ercildoun, trees and other *débris* were thrown down in what appeared to be inextricable confusion. Some of the observers state that the *débris* ascended up the centre of the funnel-shaped cloud and fell back to the ground outside it, but the tornado was too sudden, brief, and appalling to admit of careful observations being made on this point, which is all-important in its bearing on the theory of tornadoes. No tornado is known previously to have traversed this part of the United States.

THE LAW AND ORIGIN OF THUNDERSTORMS.—In the Christmas issue of the *Bulletin International* of the Paris Observatory, there is an interesting note on this subject by Prof. Ch. V. Zenger, of Prague. He has examined the thunderstorms which occurred at Prague during the ten years ending 1849, and those at Vienna during the four years ending 1875, arranging the dates of their occurrence according to the semi-solar days each period of observation embraced, there being twenty-nine such semi-solar days in each year. The general result is that, dividing the semi-solar day into three equal portions, 47 per cent. of the whole thunderstorms occurred in one of these portions, 32 per cent. in another, while only 21 per cent. occurred in the third. Prof. Zenger is of opinion that this result points to a cosmical origin for the thunderstorm, operating, no doubt, on pre-existing terrestrial conditions, an opinion which receives some countenance from the relation subsisting between thunderstorms and auroral and magnetic perturbations. The subject is of sufficient importance to call for a wider and more exhaustive treatment.

MONTHLY METEOROLOGICAL BULLETIN OF THE MONTSOURIS OBSERVATORY, No. 69.—This number gives the observations for August last, which now include, for the first time, the hourly velocities of the wind in addition to the hourly temperatures and rainfall, which were added some months ago. The daily minimum velocity of the wind, 7·2 miles per hour, for August occurred about 6 A.M., and the maximum velocity, 13·1 miles per hour, about 2 P.M., the increase in the wind's velocity being thus nearly doubled between these hours. These hours are all but coincident with the hours of mean minimum and maximum temperature. The table of the hourly amounts of the rainfall is a peculiarly valuable one. Several years must, however, elapse before its full

value will be seen in determining the curve of the diurnal variation of the rainfall. We note, with much satisfaction, the continued prosecution of the important inquiry into the chemical climatology of Paris.

METEOROLOGY OF WESTERN AUSTRALIA.—We have recently received a most valuable addition to the meteorology of Australia, which is being so energetically worked out by Messrs. Todd, Ellery, Russell, and Macdonnell, in the form of a first Report of the Meteorology of Western Australia, by Mr. Malcolm Fraser, Surveyor-General for the Colony. The report contains a good summary of a pretty complete set of observations made during the whole of 1876 at Perth, and the barometric means for five months at Point King Lighthouse, on the south coast. The chief results are, for the summer months, mean monthly pressure—29·915 inches, temperature 74°·7, rainfall 0·54 inch, and wind velocity in miles 404; and for the winter months—pressure 30·177 inches, temperature 57°·5, rainfall 4·90 inches, and wind velocity 280 miles. The lowest temperature for the year was 34°·7, and the highest 112°·0, on February 20, and it may be noted that the mean daily maxima for this month was as high as 93°·7. Speaking generally, the winds in summer blow from the sea inland, and in winter from the land seawards, little rain falling in the former season, whereas in the latter season the rainfall is copious but not excessive. The smallest rainfall of any month was 0·04 inch in February, falling on one day, and the largest 8·45 inches in June, falling on nineteen days. It is contemplated to establish stations at Nickol Bay, Champion Bay, and York; but a still further extension of the system is required, not merely for the development of the climatology of the colony, of which we may be said to know next to nothing, but also from the important bearing of the meteorology of Western Australia on that of the whole continent of Australia, particularly on the system of weather warnings for that group of colonies.

OUR ASTRONOMICAL COLUMN

THE URANIAN SATELLITES, ARIEL AND UMBRIEL.—We continue the ephemeris of the two interior satellites of Uranus, making use of Prof. Newcomb's tables in the appendix to the Washington Observations for 1873. The positions and distances are for 9h. Greenwich mean time, when the planet will be near the meridian during the period over which the ephemeris extends; though these are given for every evening, the presence of the moon in this quarter of the heavens may interfere with observation on or about March 16.

	ARIEL.		UMBRIEL.	
	Pos.	Dist.	Pos.	Dist.
	°	″	°	″
March 8	358	12·6	312	7·9
9	191	15·2	196	20·6
10	25	12·4	145	9·1
11	241	6·2	18	20·0
12	153	7·4	334	10·6
13	0	13·3	201	19·1
14	193	15·1	161	12·1
15	19	11·5	23	18·1
16	256	5·5	347	13·6
17	150	8·4	206	16·9
18	3	13·9	171	15·1
19	195	14·8	30	15·6
20	33	10·5	355	16·5
21	272	5·1	214	14·1
22	165	9·4	178	17·7
23	5	14·4	39	12·6
24	198	14·4	1	18·8

THE TRANSIT OF MERCURY ON MAY 6.—The *Nautical Almanac* furnishes the usual elements of this phenomenon and the times of the contacts and of least distance of centres referred to the centre of the earth, with the necessary formulæ for reducing the moments of contact to any place upon the earth's surface. The following figures result for Greenwich, Edinburgh, and Dublin; Greenwich mean times at the respective observatories:—

	First External Contact.	First Internal Contact.
	h. m. s.	h. m. s.
Greenwich	3 10 58	3 14 4
Edinburgh	3 11 0	3 14 6
Dublin	3 11 3	3 14 9

The least distance of the centres (4′ 47″) takes place at 6h. 58·5m. and, as the sun will set at 7h. 29m., 7h. 47m., and 7h. 36m. local mean times at these places respectively, rather more than half the transit will be visible. The final contacts may be well observed in America.

THE RADCLIFFE OBSERVATORY.—The Radcliffe Observer is again punctual in the distribution of his volume of Observations, Vol. xxxv., containing the work in the year 1875, having been in the hands of astronomers several weeks. The only new feature is the publication of observations of the solar spots; the distances from the sun's limbs are fixed by transits and by readings of the declination circle of the heliometer; descriptions and sketches of the forms of the spots are included. Nearly 1,200 stars were meridionally observed. At the end of the Introduction, Mr. Main has exhibited the apparent errors of Tabular R.A. of the moon's limbs, as given on the same day by the observers at Oxford and Greenwich in 1863 and 1864, and from 1870 to 1874 inclusive. As usual the meteorological observations taken at the Radcliffe Observatory are published in considerable detail.

THE HARVARD COLLEGE OBSERVATORY, U.S.—Prof. Pickering has issued a report of proceedings at this observatory during the year ended November 1, 1877, with an outline of the course of observations intended to be pursued in future with the 15-inch refractor and the meridian circle, the telescope of which has an aperture of eight inches. The newly-discovered satellites of Mars have been the objects to which most attention has been directed with the refractor, the observations consisting not only in a series of measures of positions and distances which Prof. Pickering believes to be second only to the very complete series obtained by the discoverer with the large Washington instrument, but in a numerous series of photometric comparisons with the planet on methods explained in the Report, by which the image of Mars was brought to the same degree of brightness as each satellite. It was remarked under favourable opportunities for comparison that the outer satellite did not partake of the red colour of Mars, which Prof. Pickering observes is "a curious result, and having an important value in any theory of the cause of the peculiar colour of Mars." The observations were not wholly reduced at the time the Report was issued, but an approximate reduction gave the diameter of the outer satellite about 5·9 miles, and that of the inner one, 6·5 miles. "As the darker colour of the outer satellite somewhat diminishes its light," it was considered safe to call it about six miles in diameter, and the inner satellite seven miles. These comparisons were made between August 27 and October 12. A large number of similar measurements of seven of the satellites of Saturn, including the very faint object, Hyperion, have also been obtained. Remarking that other classes of observation appear to be well cared for at various observatories in the United States (Dr. Peters being engaged in the determination of the small stars near the ecliptic, at Clinton; the great telescopes of Washington, Chicago, and Cincinnati, being used almost exclusively for micrometric measures; spectroscopy being the intended line of observation at Princeton College; and the telescopes of Mr. Rutherford and Dr. Draper being largely used for photographic purposes), Prof. Pickering intends to devote the Harvard refractor mainly to photometry as "a field almost wholly unexplored with large telescopes," in America or elsewhere. The meridian-circle appears to have been chiefly

employed in the determination of stars to the ninth magnitude inclusive in the zone included between + 50° and + 55° of declination, undertaken at the instance of the Astronomische Gesellschaft, and this work approaches a conclusion. Upwards of 40,000 observations have been made with the meridian-circle since it was mounted at the end of 1870. The personal establishment at Harvard College now consists of Prof. Edward C. Pickering, as director, assisted by Prof. Rogers, and Messrs. Searle, Waldo, and Upton. Vol. x. of the *Annals* of the Observatory has been published during the past year. Vol. ix., with photometric observations 1872–75, is to follow, and is nearly ready for issue.

GEOGRAPHICAL NOTES

THE ALBERT NYANZA.—In his recent examination of Albert Nyanza, to which we have already referred, Col. A. M. Mason examined every inlet or indentation of the coast-line. Starting from Magungo in the s.s. *Nyanza*, Col. Mason followed the western shore, and found it overhung by lofty mountains, notwithstanding which there seemed to be a large population. On the first day the party reached Nurswar, and on the next continued their route to the south-west; after a six hours' run, they found that the coast-line trended more to the south, forming a wide plain, which in some places was covered with very heavy, thick forests. On the third day they crossed a wide bay to Kavalee. Soon after leaving Kavalee, Col. Mason found that the coast-line turned to the eastward, and in two hours' time they reached a mass of ambatch (like Signor Gessi), and found the south end of the lake very shallow. In the south-west corner Col. Mason noticed a second large bay, and from a depression in the mountains and a thick line of forest, he fancied that there might be a river emptying into the lake at that point, but he could find no entrance, and this accorded with what he had been told at Kavalee, that no river joined the lake near there. On the morning of the fourth day, after entering a number of small, shallow bights, he finally reached a broad river, the waters of which were reddish in colour, with a slight northerly current. The width of the stream is about 400 yards, the banks high and well-defined, and clothed with forests. Col. Mason was only able to proceed up this river for one hour, owing to the shallowness of the water, and there seemed to be a mass of vegetation blocking the way to the south; to the south-east he observed an immense forest of date-palms, and to the south and south-west an undulating country, covered with large trees. After leaving this river he found that he had crossed the lake, and that their course turned to the northward. On both sides of the lake the mountains were found to diminish in altitude, and to the southward, at the foot of the lake and between the two ranges, was a large isolated mountain, which was found to be in N. lat. 1° 11′. It is clear, therefore, that Lake Albert does not extend, as has been asserted, to the first parallel of north latitude. In his northward course Col. Mason found that the mountains were not so high as on the western shore, and that in only one place were the cliffs as lofty as the highest on the opposite coast. There was a marked difference, too, in the vegetation; on the western shore the mountains are well covered with timber and verdure, and in many parts the natives have cleared places for cultivation, while on the east the mountains are barren, with neither timber nor vegetation. On the fifth day the party passed several large villages, one of which was said to be the residence of Kava Gonza, brother to Kaba Rega, and, soon after, the village of Tiaboa was reached, above which the country is flat, and the coast-line trends to the north. From his observations Col. Mason found that Kavalee, near the south-west angle of Lake Albert, was in N. lat. 1° 22′ 20″, and the south-east angle in N. lat. 1° 11′ 3″.

MR. STANLEY'S WORK.—Mr. Stanley is engaged in writing a full account of his most important journey across Africa; and at present he is doing so with characteristic energy. Already a large portion of his manuscript is in the printer's hands, and his work will doubtless be ready for publication in May next. Mr. Stanley carried with him through the whole of his arduous journey a heavy photographic apparatus, and succeeded in obtaining many very good negatives of views and groups on the great lakes and on the Congo. The interest of these pictures can scarcely be over-estimated. They will be reproduced as full-page woodcuts in the volumes, which will also contain an unusually large number of vivid scenes and incidents from excellent sketches made by Mr. Stanley himself. Perhaps the most important feature of the work will be the chart of the Congo, which has been so minutely and elaborately mapped, that it will require a scale of an inch and a half to a degree to embody in the smallest writing the information conveyed. Besides this large route map, which will be in two parts, the work will also contain several maps of a valuable and interesting character. The work will be published simultaneously, the *Publishers' Circular* informs us, or as nearly so as can be arranged, by Messrs. Sampson Low and Co. in England; by Messrs. Harper and Brothers, New York; in French by Messrs. Hachette and Co., Paris; in German by M. Brockhaus, Leipsic; in Danish by M. Mallings, of Christiania. Negotiations are also pending for translations into the Swedish, Spanish, Italian, and Russian languages. The title is, "Through the Dark Continent; the Sources of the Nile; around the Great Lakes, and down the Congo." We are pleased to see that the *Geographical Magazine* of this month handsomely acknowledges that its previous hard judgment on Mr. Stanley's conduct was unjustifiable.

SOUTH-WEST AFRICA.—In his monthly summary, Dr. Behm refers briefly to an important journey made by two Rhenish missionaries last summer between the Cunane river and 21° south lat. They found that the coast mountains, opposite Wallfisch Bay, extend far to the north-west, with a height of from 4,000 to 4,500 feet. The travellers have noted many important details in their map which will form an important supplement to existing maps of Africa, as the region traversed is almost unknown.

AFRICAN DWARFS.—Dr. O. Lenz contributes to the *Mittheilungen* of the Vienna Geographical Society for January an important paper on this subject. He describes his own observations on the Abongo of the Ogové, whose average height is 133-152 centimetres. Dr. Lenz concludes that all the dwarfish African peoples—the Abongo of the Ogové, the Dongo of the Sette River, the Bakke-Bakke of the Loango Coast—are only part of an original great negro people, who are also found in the interior under various names—as Kenkob in the Lufum country, Mala-Gilagé in the south of Bagirmi; and further east, as Akka, Doko, Berikomo, &c.; and that this great people, who were perhaps the aboriginal inhabitants, the true autochthones of equatorial Africa, have been supplanted and destroyed by other migratory peoples. Dr. Lenz places the Bushmen in a similar category.

THE NORTH-EAST PASSAGE.—Prof. Nordenskjöld and Mr. Dickson of Göteborg, recently paid a visit to Hull in order to make various preparations for their intended Arctic expedition. It is also announced that Lieut. Sandeberg intends to organise a scientific expedition to Kolgajeff, the Petchora, Hvideö, and the Siberian coast during the approaching summer; he has already hired a vessel for this purpose, and intends to be absent for about six months.

DR. LENZ.—The well-known African traveller, Dr Oskar Lenz, has been presented with the cross of the Albrecht Order by the King of Saxony.

POPULAR NATURAL HISTORY[1]

WE have to congratulate the publishers of this fine volume on its appearance, for, on a careful perusal, it strikes us as very eminently fitted to supply a known public want. On one or two previous occasions the same firm have published large and well-illustrated works on natural history, the descriptive portions of which were, to say the least possible of them, not in any way up to the science of the day; but we have lately gladly witnessed an infinitely more careful editing of such works on natural history as have been published by Cassell and Co., and the present work, so far as its descriptive portion is concerned, can boast of being written by men so well known as Duncan, Dallas, and Murie, while the illustrations,

FIG. 1.—The Negro Monkey (*Semnopithecus maurus*).

many of which are very beautiful, and the general style of the get-up of the volume may well be left to tell their own tale.

The work aims at being an encyclopædia of the Natural History of the Animal Kingdom, and this, which forms its first volume, contains an account of the apes and monkeys, by the Editor; of the lemurs, by Dr. Murie, and of the bats and insect-eating mammals, by Mr. Dallas. May we, in the interest of the success of the work, suggest, that in order to complete the publication of such a work, within a reasonable time, there ought to be different portions of it simultaneously published. Thus there would be nothing to hinder the volumes on fishes being published alongside of those of the mammals, and it would be decidedly well to publish those volumes that will treat of the sponges and corals long before this portion of the animal kingdom would in the ordinary course be reached; but we venture this only as a suggestion.

The Editor tells us that the volume before us is meant to explain the many interesting facts of the natural history of animals, and that every endeavour has been made to unite zoology with comparative anatomy; the aim is high and the idea is a good one, but the authors sometimes fail to come up to the standard they hold before them. It is perhaps not to be wondered at, for do not the very words of our English language seem to fight against the perfect accomplishment of such aims. Vertebra, says Dr. Duncan, is a Latin word, which means "a turning joint in the body," *or*, "a back bone." What idea will the English youth take away of this Latin word?

We regret a little to see the attempt to give each animal what we suppose we must call an English name, and we are tempted to ask, Which is it easier to say, *Troglodytes calvus* or *Nschiegombouve?* The former is the scientific name of a little-known ape; the latter is the name we are to make believe, as the young folk say, is English. It would have been better if both names had been equally conspicuous, then we could have taken our choice, and we can see no good reason for burying the scientific name in a foot-note.

As specimens of the style and illustrations, we have selected the following:—"The Negro Monkey (*Semnopithecus maurus*) (Fig. 1) is of an intensely black colour, except underneath, and at the root of the tail, where there is a grey tint. The paws are long, delicate, and silky, and become slightly grey on the head and back with old age. Like most black things it leads a troubled life, being chased and hunted, not, however, in the Javanese forests, and sometimes fifty or more individuals associate together. The Negro Monkeys make rude nests on trees, and are extremely timid, making off with great haste if they are disturbed. A long series of generations have been chased and killed by the natives of Java, and therefore the present Negro Monkeys are exceedingly shy, and bolt from the face of man at once. And yet, although thus timid and anxious to get out of the way, they have the reputation of being dangerous, and really unwittingly they may be so. On the approach of men they utter loud screams, and scamper off amongst the trees, helter-skelter. Now in doing this they break dead branches off, and sometimes a large fruit or nut comes tumbling down some score or two of feet. These are supposed to be thrown by the monkeys, but such is not the case. Having this bad character, the 'Negroes' are cudgelled with sticks, and killed in numbers very cruelly. Their pretty fur is much prized, and the chiefs of the country arrange the hunting parties, treating the monkeys really as beasts of the field. The skin is prepared by a simple process which the natives have learned from Europeans, and they conduct it with great skill. It affords a fur of a jet-black colour, covered with long silky hairs, which is used by the natives and Europeans there in ornamenting riding saddlery and in military decoration.

"When young they are of a brown or reddish tint, and thin grey tints appear preceding the intense black; they then eat buds and shoots and tender leaves, but in adult age they are fruit-consumers. When in captivity they are sullen and morose, and they will remain sulky for many months. This the natives know, and therefore they never try to tame them or to have them in their houses."

Another pretty illustration taken from the *Proceedings* of the London Zoological Society, is that of the Red-bellied Monkey (*Cercopithecus erythrogaster*), which is described as follows:—

"When living at the Zoological Gardens in the Regent's

[1] "Cassell's Natural History," edited by P. Martin Duncan, M.B. (Lond.), F.R.S. Vol. i. Illustrated. (Cassell, Petter, and Galpin, London, Paris, and New York.)

Park, this pretty monkey, with a red chest and belly, and slim tail, was very timid, but it liked to be petted by the keeper, being somewhat distrustful of its more romping companions. It would take food out of his hand, and seemed pleased, and generally played with his fingers without attempting to bite. The canine teeth were very moderately grown (Fig. 2).

"This monkey inhabits Western Africa, and is at once known by the red belly and chest, the white beard and whiskers, and the black band across the forehead. It has, moreover, a yellow crown."

As a last illustration we select that of a most remarkable animal, the West African River Shrew (*Potamogale velox*, Fig. 3).

"This was originally described by its discoverer, M. du Chaillu, as a carnivore, under the name of *Cynogale velox*, but as its characters were very doubtful, the name *Potamogale* was suggested for it in case of its proving to belong to a distinct genus. The late Dr. Gray described it as a rodent under the name of *Mythomis*. Some years later Prof. Allman and Prof. Barboza du Bocage procured perfect specimens, and proved the animal to belong to the

FIG. 2.—Red-bellied Monkey (*Cercopithecus erythrogaster*).

insectivora, the latter naturalist describing it under the new name of *Bayonia velox*. Thus within a few years it received no less than three different names.

When the insectivorous nature of Du Chaillu's River Shrew was ascertained, it was found to be most nearly allied to the Centetidæ or Tanrecs, with special affinities to the West Indian Solenodens. It is, however, generally regarded as constituting a distinct family, characterised, among other things, by the less cylindrical skull, the absence of clavicles, the union of the two bones of the shank towards the extremity, the presence of anal glands, and the compressed form of the tail. The teeth, as in the true Tanrecs, are forty in number, but the molars differ considerably in form, as will be seen from the annexed figures.

This little beast, which has given rise to so much discussion among zoologists, and received so many names, is only a little larger than our common stoat, measuring about nine inches in length, exclusive of the powerful tail, which is of about the same length. In its appearance it very much reminds one of a miniature otter, from which, however, it differs considerably in the form of the head, which terminates in a broad flattened muzzle, having its sides furnished with a most luxuriant crop of stiff bristle-like whiskers. The hair of the upper part of the body and limbs is brown and soft, although rather coarse, and that of the lower surface yellowish; and the coat consists of two kinds of hairs, namely, an inner coat of very fine short silky hairs, through which longer hairs of a very

peculiar structure project. These long hairs are very thin at the bulb, and increase very gradually in thickness for about one-third of their length, when they suddenly contract a little, and then expand into a flat lance-shaped blade, which terminates in a very fine point. This coarser part covers the whole body, the thick root of the tail, and the upper part of the limbs; the rest of the tail, the under side of the muzzle, and the upper surface of the feet are clothed with short, close hairs. The ears are of moderate size, the eyes very small, and the toes on all the feet, five in number, are armed with small sharp claws, and without webs, but the second and third toes on the hind feet are united as far as the end of the first phalanx.

The most remarkable peculiarity of the animal is its tail, which presents a most unusual development for an insectivorous mammal. Prof. Allman says:—"It is so thick at its base that the trunk seems uninterruptedly continued into it; but it soon becomes laterally compressed, and then grows gradually thinner and narrower towards the tip. . . . . Its lower edge is rounded, and its upper is continued into a membranous crest about one-eighth of an inch in height, and clothed with the same short, stiff, appressed hairs" as the rest of the tail.

This great development of the tail might of itself convince us that this organ is of great service to its owner, and such, from the account of the habits of the animal given by its discoverer, is evidently the case. M. du Chaillu says:—"This extraordinary animal (Fig. 3) is found in the mountains of the interior, or in the hilly country explored by me north and south of the equator. It is found along the water-courses of limpid and clear streams, where fish are abundant. It hides under rocks along these streams, lying in wait for fish. It swims through the water with a rapidity which astonished me; before the fish has time to move it is caught. On account of the rapidity of its movements I have given it the specific name of *Velox*. The animal returns to land with its prey almost as rapidly as it started from its place of concealment. The great motive power of the animal in the water seems to be in its tail."

FIG. 3.—West African River Shrew (*Potamogale velox*).

So far as we have been able to read over this volume, we have found that great pains have been taken to record all the novel facts known about the animals here treated of. We perceive an account of the nest-building power of that most extraordinary Madagascar lemur, the Aye-Aye (*Cheiromys madagascarensis*) and the strange instances of mimicry about the bats, first noticed by Dr. Dobson, is to be found also noticed.

An index to each volume would be a very desirable addition.

NITRIFICATION

THE origin of salpetre is a subject which has vexed the minds of several generations of chemists. Nitrate of potassium, or salpetre, is found in nature as a white crust, appearing on certain rocks, old walls, and even upon the surface of the soil; from this mode of occurrence the name "salpetre" is doubtless derived. The largest natural source of salpetre is afforded by certain soils in India. Soil having a white film of salt on the surface is collected from the neighbourhood of house-drains and stables; the soil is washed with water, and the nitre crystallised from the solution. With this Indian salpetre England has been, till quite recently, almost exclusively supplied. The countries of Continental Europe, not having access to so considerable a natural source of nitre, have been obliged from early times to produce nitre for themselves. At first the earthen floors of cottages and stables were collected, washed, and nitrate of potassium obtained by treatment with wood-ashes and crystallisation; but the inconvenience of collecting such material, and its general poverty in nitre, soon led to attempts

at producing salpetre by artificial means. To Glauber, a chemist of the seventeenth century, apparently belongs the credit of first preparing nitre artificially. The process as carried out in the present day is in outline as follows:—Soil, containing more or less of vegetable mould and carbonate of calcium, is mixed with a certain proportion of stable manure or other refuse animal matter, and disposed in small heaps, care being taken that the mass of soil and manure shall be sufficiently porous to ensure the free admission of air: these heaps are protected from rain, and are from time to time watered with stable sewage. At the end of two or three years the earth is sufficiently rich in nitre to be worth extracting. This tedious process for manufacturing nitre has, during the last few years, been superseded to a considerable extent by the treatment of Peruvian nitrate of sodium with chloride of potassium, by which nitrate of potassium and chloride of sodium are produced.

It is evident that the artificial nitre-beds just described, merely perform, on an exaggerated scale, an operation which occurs naturally in all ordinary soils. The chemical analysis of drainage waters has taught us that such waters are characteristically rich in nitrates, and that the amount of nitric acid present stands generally in close relation to the quantity of nitrogenous manure previously applied to the soil. The published analyses of the drainage waters from the experimental wheat-field at Rothamsted, show that ammonium salts applied as manure are rapidly converted into nitrates by the soil, the quantity of nitric acid in the drainage water being proportional to the amount of ammonium salt applied. The recent application of soil for the purification of sewage is another striking example of the same action. The sewage, as poured upon the soil, contains ammonia, and putrescible organic matter rich in nitrogen; the sewage which has filtered through a few feet of porous soil is found to contain nitrates, but only traces of organic nitrogen or ammonia.

What explanation can we give of this phenomenon of nitrification? It is clearly a process in which nitrogen is oxidised into nitric acid; but how is this oxidation brought about? The old chemists believed that a decaying organic body evolved more or less of its nitrogen in a free state, and that this nitrogen, while nascent, combined with the oxygen of the air to form nitric acid. This view has been held by some down to the present day. Hofmann, in his Exhibition Report of 1862, offers the same explanation, only substituting for free air the oxygen condensed on the surface of porous bodies. This theory has been extended by some to include the ordinary nitrogen of the atmosphere, so that on their view nitric acid may be formed in soil from the nitrogen and oxygen of the atmosphere, without the intervention of other nitrogenous matter. According to others the oxidation of gaseous nitrogen is brought about not by ordinary oxygen, but by ozone. Other chemists have inclined to the belief that nitrogen is never oxidised in the soil except when in the form of ammonia, and that the nitrogen of organic matter is always converted into ammonia as a preliminary to nitrification. According to some experiments, the ferric oxide, which gives a red colour to so many of our soils, is itself an oxidising agent, and capable of converting ammonia into nitric acid.

We need not, however, enumerate all the opinions that have been held on this confessedly obscure subject. Many of the experiments which were thought to support certain views, now appear, in the light of recent evidence, of little value. Before, however, discussing the new facts recently contributed to the subject, we may just indicate those points which have been most clearly established.

There is very little evidence for supposing that gaseous nitrogen is ever converted into nitric acid in the soil. Nitrous and nitric acid are indeed produced by electric discharges through the atmosphere, thus originating the small amount of nitrates brought to the soil by rain, but this appears to be the only reaction capable of producing nitric acid from the direct union of oxygen and nitrogen. According to Carius even ozone is quite incapable of oxidising gaseous nitrogen. Ammonia is, on the other hand, oxidised by ozone, nitric acid being formed; but that ozone is an agent in soil transformations is certainly unproved, and appears very improbable. There remains the action of ferric oxide, already referred to. This reaction deserves further study; it cannot, however, be considered as generally important, since nitrification certainly occurs with vigour in soils practically destitute of ferric oxide.

The researches of successive generations of chemists had thus failed to give any satisfactory explanation of the important phenomenon of nitrification. The subject has quite lately been attacked by Schloesing and Müntz from an entirely new point of view; their results, published in the early part of last year, plainly indicate that nitrification, instead of being brought about by purely chemical forces is, in fact, the work of a living organism. The evidence adduced in support of this new view is very simple. These chemists show that nitrification, however active, is immediately stopped by the vapour of chloroform, a substance which previous study has shown to suspend the action of yeast, and of all organised ferments. They also find that when nitrification has thus been suspended for many weeks, it can be restarted by the addition of a small quantity of a nitrifying body. In a second communication they further prove that the temperature of boiling water is sufficient to destroy all power of nitrification, and that soil which has been once heated to this point produces, in air free from germs, carbonic acid and ammonia, but no nitrates. If, however, this soil is moistened with water containing a little unheated soil, the production of nitric acid again commences.

This new theory of nitrification has been investigated at Rothamsted with results completely confirmatory of the views put forward by these French chemists. It was found that the vapour of bisulphide of carbon, and of chloroform, effectually prevented nitrification in a moist garden soil through which air was frequently aspirated, while without these vapours the soil produced nitrates in considerable quantity. A solution of chloride of ammonium containing a little tartaric acid, phosphate of potassium, and carbonate of calcium, was also completely nitrified in a few weeks by the addition of a small quantity of soil taken from the "fairy-ring" of a meadow. This solution, when nitrified, was successfully used as seed to produce nitrification in other similar solutions, which, without this addition, produced no nitric acid. It was further shown that light was prejudicial to nitrification; solutions kept in a dark cupboard producing nitric acid, while similar solutions standing in daylight produced none.

The evidence has thus become very strong that the nitrates in soil owe their origin to oxidation brought about by living organisms. That mycoderms, in their processes of life, may exert a powerful oxidising action upon organic matter, we have already learnt through the researches of Pasteur and others. The most familiar example is that of the acetic fermentation. Vinegar is produced by the oxidation of alcohol during the growth of a very simple organism, the *Mycoderma aceti*, without the growth of such an organism no vinegar is ever formed. It is by similar low organisms that fermentation of all kinds is brought about. Putrefaction has also been shown to be equally dependent on the presence of microscopic organisms, and except under the conditions suitable for their rapid development putrefaction will not take place. With this abundant evidence before us of the energetic decomposition of organic matter, brought about by what we may term microscopic fungi, we can hardly be astonished to find that the same agency is capable of

oxidising the nitrogen of organic matter and of ammonia, and thus producing nitric acid.

The organisms which produce these wonderful changes consist of colourless cells; they are independent of daylight, for they derive their supply of carbon exclusively from organised matter, and from the decomposition of such matter they obtain the force necessary for life and growth. In these respects they differ entirely from green vegetation, in which sunlight is the source of all energy, and carbonic acid gas, decomposed by the aid of light, the material from which carbon is derived. The colourless and green organisms, however, equally require phosphoric acid, potash, and other ash constituents; and both appear to be capable of assimilating nitrogen in the form of ammonia.

Not only are these simple organisms independent of the aid of light, but light is, in some cases at least, actually fatal to their existence. This fact has quite recently been established by Downes and Blunt. They find that the *bacteria* present in an organic fluid may in many cases be entirely destroyed by exposure of the solution to daylight, and that even when this is not the case, their development is much retarded by such treatment. This observation is perfectly in accordance with the fact observed at Rothamsted, that nitrification did not proceed in solutions exposed to daylight. In the last communication of Schloesing and Müntz, it is stated that vegetable soil suspended in water by passing a stream of air through the mixture, undergoes nitrification both in light and darkness. No details of the experiment are given, but it seems probable that such a mixture would be more or less opaque, and the greater bulk of the material consequently at all times in partial darkness.

The microscopic organism producing nitrification has probably distinctive characters, and might be isolated by cultivation under conditions specially suitable to its growth, but more or less unfavourable to the life of other associated germs. Pasteur has pursued this method with success in the case of beer yeast, and has shown that with the pure yeast thus obtained an unchangeable beer may be manufactured, the organisms producing secondary changes having been excluded. The subject of nitrification has clearly reached a stage which demands the aid of the vegetable physiologist. R. WARINGTON

FOSSIL HUNTING AT BOURNEMOUTH

I HAVE recently deposited in the South Kensington Museum some unusually large specimens of fossil plant remains from Bournemouth and Studland. The matrix in which these are imbedded is friable, and the remains, in most cases, are extremely difficult to extract, so that a brief account of the process employed may be of use to would-be collectors. The largest specimen, part of the frond of a feather-palm, measures 4 ft. by 3 ft., and as this presented the greatest difficulties, I will more particularly describe the work which its preservation involved.

In digging last autumn at Bournemouth in a bed of dark clay about 60 feet above the sea-level, and about the same distance from the top of the cliff, we came across a well-preserved fragment of this specimen consisting of a portion of the stem with the bases of pinnæ attached. We included a younger athletic brother, a coast-guardsman whom I have long employed, as well as myself, and occasional other assistance. The tools we used were pick-axes, crow-bar, and spades. The place was a slightly projecting ledge, none too solid, with a steep cliff above and below. So soon as the fragment mentioned was brought to light by a stroke of the pick digging was stopped, and a careful examination was made by the aid of our knives to see in which direction the frond trended. Finding, fortunately, that the direction was towards the mass of the cliff, we determined to use our endeavours to extract it in as perfect a condition as might be. We therefore, at about mid-day, commenced to dig away the superincumbent mass until a slab was bared at least twice the size of that ultimately required, when we proceeded to clear down and lay bare the specimen. Loose sand blowing up in clouds, however, settled upon it and threatened to adhere so firmly to the wet clay that it was feared it might be found impossible to remove it, whilst the drying action of the wind caused it to crack and peel, notwithstanding all our efforts to keep it covered with damp paper and linen. It was then determined to remove the slab without exposing the leaf, leaving that operation until it was safely housed at home, and we therefore commenced the laborious operation of undermining this great slab and removing it in such pieces as from time to time broke away by their own weight from the main mass. For five hours these pieces kept breaking away in blocks of about one foot in thickness, and as much in weight as two or three of us could lift. At dusk our task was not more than two-thirds completed, but as wet was expected, it was determined to extract the whole that night if possible. Perhaps the most toilsome part of the work was carrying the pieces up the sixty feet of cliff. A hand-barrow having been improvised, it required our united efforts to convey each piece to the path above, and this was really hard work, and in addition I had great anxiety throughout lest the edges should be rubbed. Notwithstanding all our trouble we had the mortification of seeing our large lumps repeatedly break and subdivide. The work went on until about 9 P.M., when we found it impossible to continue, and therefore carefully covered up the remains of the slab, the vicinity of a populous town rendering this precaution necessary. The next day the whole of the pieces were removed in a cart from the coast-guards station to an out-house in our occupation. When they arrived there the prospect was far from hopeful. We had apparently but a truckful of lumps of black wet clay, a foot or more in thickness, and varying in diameter from a few inches to two or three feet, the majority without trace of the fossil upon them, or any marks or indication of how they were to be fitted together. Experience among these fossils has taught me not easily to despair, and I knew, moreover, from the care that had been taken, that the edges could not be much abraded, nor could any considerable pieces be missing. Our lodging contained a new and comparatively well-lit cellar, to which all was removed. A table was next made, six feet long and four feet wide, and portions of three days occupied in ascertaining how the pieces could be fitted together.

Two days were then lost in fastening the smaller pieces together into larger slabs, but it was found that these larger pieces would not come together properly in the box, their relative thickness, &c., being different. They were next reduced in thickness to about three inches and transferred to the box in which they now are, and fitted together as accurately as possible and fixed by glue and plaster of Paris, ¾ cwt. of the latter being used.

A great disappointment now awaited us. From standing and kneeling upon the slab whilst engaged in digging it out, the upper surface of the leaf was kneaded into the under surface, and would not part for weeks afterwards, until quite dry, and then in very small fragments only.

Another difficulty was that two other fronds were found at lower levels traversing the one we were endeavouring to save, and in some places these had been cleaned out before the mistake was discovered. The base of the frond, it will be seen, has been abandoned altogether, and not more than two-thirds is now preserved. The next thing was to get it to London safely, and the railway officials were cautioned as to the care required and the necessity of keeping it flat and right side up, and the case was

insured. Even while I was in the office insuring it a stupid porter tilted it over face downwards to my great grief, as I had little hope that the plaster would hold with such a weight if the case were subjected to this treatment on the way. I was relieved in my mind a few days later by its safe arrival at home. From this time patience alone was required, and by Christmas, with the aid of Mr. De Wilde, the whole leaf was uncovered and varnished and all the cracks filled in with modelling clay.

The other specimens were obtained in more or less the same way. The small feather palm was extracted whole with the assistance of Mr. Henry Keeping, of the Woodwardian Museum, but fell to pieces on the shutter to which it was transferred for carriage, and great care was needed to put them together as they now are. The Studland fan-palm being rotted by exposure on the face of the cliff and being penetrated everywhere by rootlets, fell into a hundred pieces, and only the centre of the leaf could be pieced together the rest being pulverised in its journey from Studland to Wareham.

J. S. GARDNER

FATHER SECCHI

SOME little time ago we announced the serious illness of Father Secchi, the well-known astronomer and Director of the Observatory of the Collegio Romano, at Rome; last week we chronicled his death, which occurred on the 26th ult. The illness which has thus terminated fatally, has cut him off, we may say, in the prime of his life, and in the midst of his work; for, till he was taken ill, there were no signs of any diminution of his energy, and he was only fifty-nine years of age when he died.

Secchi was born at Reggio, on June 29, 1818. Educated and trained from early youth as a Jesuit, we hear of him first in connection with science as Professor of Physics at Georgetown College, near Washington, and next as holding the same chair in the Roman College at Rome. It was in connection with the observatory attached to this institution that almost all Secchi's work for the last thirty years has been done. While the Roman College was in papal hands no funds were spared to make the observatory as complete as possible. Secchi had instruments and assistants in abundance, and his various series of "Memoirs" testify to his industry in many fields, while his position gave him great facilities for giving the widest publicity to his work. What he lacked in originality he made up in assiduity, and hence, although he has left no great life work on any one subject behind him, there is, we think, hardly any question which has turned up touching observations in astronomy, magnetism or meteorology on which a multitude of papers have not been written by his busy pen. Many of these papers are very admirable and show great penetration and power of generalisation as well as a wide grasp of many subjects.

Secchi's great interest in solar physics was doubtless aroused, when in America, by assisting Prof. Henry in making the first experiments on the heat radiated by different portions of the sun's disc by means of the thermo-electric pile. His interest in spectroscopy dates from Janssen's visit to Rome, when on his scientific mission to Italy and Greece. In both these branches of work Secchi has been an ardent observer and voluminous writer. He photographed the eclipse of 1860 in Spain, and observed the one of 1870 in Sicily. In 1867 he was in Paris exhibiting his universal meteorograph in the exhibition of that year, and giving lectures, some of which eventually formed the basis of his book on the Sun, a second edition of which appeared last year. Besides this book on the Sun, he has written others on the Unity of the Physical Forces, and on the Stars, the latter of which has not yet appeared.

When the States of the Church became Italian the Roman College was among the institutions which were turned to other uses by the new government. This now contains two most interesting museums, one of educational apparatus chiefly for primary instruction, and another for antiquities. The new Government, however, were extremely anxious not to interfere with Secchi's scientific labours and offered him the Chair of Astronomy in the new Roman University, at the same time granting ample funds for the prosecution of his inquiries. This Secchi accepted, but soon found his occupation gone, as he was commanded by the chief of the Jesuits to resign it, which he did. It is doubtful whether any *modus vivendi* would have been found if the king, whose foster-brother he was, had not stepped in between the Ministry and the Vatican, and suggested a compromise which would have left Secchi to continue his work under most favourable conditions, if the Jesuits had not again stepped in.

One of the most recent results of Secchi's energy has been the foundation of the Societá degli Spettroscopisti Italiani, a society specially constituted for recording daily spectroscopic observations of the sun, chiefly at the various observatories of Italy.

There is no doubt that in the death of Father Secchi observational astronomy has sustained a great loss. His industry and skill were largely rewarded during his lifetime. In 1867 he received the great French prize of 100,000 francs. He was a member of most scientific societies, including our own Royal Society, and it must not be forgotten that if there may have been traits of Secchi's character open to criticism, the exigencies of his post, rather than the inclinations of the man, may have been to blame.

NOTES

THE French expedition for the observation of the approaching transit of Mercury consists of M. C. André and M. Angot, who formed likewise part of the expedition to New Caledonia, on the occasion of the transit of Venus. Ogden, in the State of Utah, has been selected by the French Institute as the most favourable locality for the observation, and the expedition is already under way to its destination. A Parisian millionaire, well known for his generosity towards scientific objects, has contributed 30,000 francs to defray the expenses of the observation.

WE regret to learn of the dangerous illness of the well-known mineralogist, M. Delafosse Gabriel, professor at the Muséum d'Histoire Naturelle of Paris. He is now in his eighty-third year, and has been for twenty years a member of the French Academy of Sciences.

THE Royal Academy of Sciences at Berlin has elected the well-known Prof. Noeldecke, of Strassburg, a corresponding member.

ARRANGEMENTS are being made at Paris for the erection of a fitting monument to the late Claude Bernard. The initiative has been made by the *Société de Biologie*, of which Bernard was one of the founders, and over the meetings of which he has presided during the past eleven years. The committee appointed for the purpose contains prominent names from all the leading scientific institutions of Paris.

THE death is announced of Mr. Joseph Bonomi, the distinguished Egyptologist, which occurred at Wimbledon Park on Sunday last, at the age of eighty-two. For the last sixteen years Mr. Bonomi has acted as Curator of the Soane Museum in Lincoln's Inn Fields. Mr. Bonomi went out to Egypt as early as 1824, and spent eight years on the banks of the Nile, drawing and studying the ancient temples and their wonderful sculptures. During this time he had adopted the Arab costume and mode of living, and by this means he was able to go on in the prosecution of his studies with his then limited resources. He returned

to England, where he remained till the visit of Lepsius in 1842, when he went out as artist in that expedition, which resulted in a large folio work of about twenty vols., published under the auspices of the King of Prussia. The Egyptian Court at the Crystal Palace was erected from Mr. Bonomi's designs and under his superintendence. He was also employed in the British Museum in arranging the department of Egyptian antiquities. Mr. Bonomi has rendered great service, not only by his illustrations, but also by his writings on subjects connected with the various countries in the east which he visited. These will be found in the *Transactions* of the Royal Society of Literature, Syro-Egyptian Society, British Association, &c. Mr. Bonomi leaves a great mass of notes and sketches of hieroglyphics which may yet be of great value to Egyptology.

AT the General Monthly Meeting of the Royal Institution on Monday, the special thanks of the members were given to Mr. Warren De la Rue, D.C.L., for his donation of 50*l.* for the benefit of the Chemical Laboratory.

WE would remind our readers that subscriptions are still being received for the Simon Testimonial Fund. A marble bust is the form of testimonial that has been decided on, and a small copy of this will be presented to each subscriber of two guineas and upwards. No testimonial was ever better deserved. Subscriptions may be sent to Robarts, Lubbock, and Co., Lombard Street, to the Hon. Secretary, 1, Adam Street, Adelphi, or to the Treasurer, General Register Office, Somerset House.

THE Atlas of Colorado, soon to be issued by the U.S. Geological Survey of the Territories, under Prof. F. V. Hayden, embodies the results of the geological and geographical work of the survey during the years from 1873 to 1876 inclusive. This Atlas will contain the following maps:—1. A general drainage map of Colorado on a scale of twelve miles to the inch. 2. An economic map of the same region, having as its basis the above-mentioned drainage map. This map will indicate the areas of arable, pasture, timber, coal, mineral, and desert land in as great detail as possible on the scale. 3. A general geological map, on which the areas covered by the principal formations will be shown. The drainage map will form the basis for this also. 4. A map showing the scheme of the primary triangulation in the state. Scale twelve miles to the inch. 5. Six topographical sheets showing the same area as that covered by the general drainage map, but in much more detail. The scale of these sheets is four miles to an inch. The relief of the country is indicated by contour lines, at vertical intervals of 200 feet. The area covered by each of these sheets is 11,500 square miles. 6. Six geological sheets, of which the bases are the six topographical sheets just mentioned. On these the detailed geology is expressed by colours. With the appearance of this map, Colorado will be better known, topographically and geologically, than any other State.

ONE of the leading publishing houses of Paris is making arrangements for the speedy appearance of an enormous work, "Études sur l'Exposition de 1878," under the direction of M. E. Lacroix. This work is intended to be a complete record of the progress made in all the arts up to the present date, and its thoroughness and value have been assured by the promised co-operation of a large number of leading authorities. The French Ministers of Public Works, of Commerce, and of Agriculture have already promised all necessary assistance on the part of the Government, so that the undertaking will start under the most favourable auspices.

DR. SCHLIEMANN intends to resume his excavations at Hissarlik as soon as the country is at all safe to live in.

THE Society of Arts prize of 10*l.* for the best set of blowpipe apparatus that could be sold retail for one guinea, has been awarded to Messrs. Letcher, of Camborne and St. Day, Cornwall. A second prize, consisting of a bronze medal, has been awarded to Herr Osterland, of Freiberg.

THE establishing of a branch of the U.S. National Observatory, to be placed at some elevated point in the West, has lately been agitated, and much is expected as the result of its completion.

ON July 16 an International Exhibition of the Paper Trade will be opened at Berlin and will last until August 31. The programme of the exhibition is already finally settled, and the objects exhibited will be divided into eight different groups, viz.: 1. Raw materials and articles used for making paper, pasteboard, &c. 2. Machines and tools used for making and working paper. 3. Paper and boards of all descriptions. 4. Paper, as far as it is employed for printing, paper-hangings, &c. 5. Articles made of paper or *papier-mâché*. 6. Paper as used for technical or building purposes. 7. Writing and drawing materials. 8. Objects, books, &c., relating to the history and literature of paper. A number of prizes will be awarded for the best contributions.

THE system of agricultural weather-warnings in France, carried on under the direction of the Paris Observatory, continues to be rapidly developed and extended to all parts of the country. The warnings are now sent to 1,432 communes spread over all the departments of France except that of Lozère.

A NOVEL and valuable application of electricity, designed to prevent the possibility of collisions on railways, is now the subject of experiment in the Marseilles station. It consists of an electric mirror, in which all the movements on a line 100 kilometres in length are brought vividly before the eye, and enables the station-masters to follow exactly the progress of every train. By this means it is hoped that all accidents resulting from delays or too rapid runs can be entirely avoided, and arrangements are being made for the general introduction into the stations of the new invention.

A VIENNA mechanician has recently succeeded, after many fruitless trials, in constructing a sewing machine which does not require the person working at it to submit to the unpleasant and unhealthy necessity of constant bodily exertion, viz., setting the machine in motion by the foot. Since, for pecuniary reasons, the application of electricity, steam, or water power was impossible, the inventor of the new machine was restricted to gravitation or elasticity, and he, preferring the latter force, has contrived to make springs strong enough to keep an ordinary sized machine in motion for hours. A system of cog-wheels is arranged underneath the surface of the table upon which the machine is fixed, and by a handle at the side the spring is wound up with the greatest facility. The velocity at which the machine works is entirely at the option of the person using it, and can be regulated *ad libitum*, and in the simplest manner.

OPPORTUNITY has been taken recently by MM. Raehlmann and Witkowski to observe the eye-motions of persons asleep, new-born children, blind persons, and also in circumstances presenting some resemblance to sleep, viz., drowsiness, intoxication, chloroformic sleep, and epileptic attacks, these cases having in common the failure of the will or the power for binocular vision. In every instance strongly uncoordinated movements were observed. The result is regarded as opposed to the idea of a mechanism possessed at birth for producing regular motions of the eyes, and as agreeing with Helmholtz's view:—"Though each eye has a quite independent muscular mechanism . . . . we have only learned to perform those movements which are necessary for seeing a real point distinctly and simply." Where this interest is not yet present, as in newly-born infants, or where it disappears, as in the case of the blind, and in the sleeping, there occur divergences from the law of adaptation.

THE German Verein zur Beförderung des Gewerbfleisses has offered extensive prizes for the invention of substitutes for caoutchouc and gutta-percha.

NEWS from South America states that powerful waterspouts were recently experienced at Callao, doing considerable damage in the town and its environs. On January 27 Callao suffered again severely from a repetition of the phenomenon known as the "tidal wave," from which so much damage was done in May last. Much destruction of buildings has resulted. On January 23 a strong earthquake, lasting thirty seconds, was felt at Iquique and Arica; shocks recurred on the 24th and 25th. On December 31 a violent thunderstorm visited Lima, accompanied by torrents of rain. The latter phenomenon is of extreme rarity in that neighbourhood, and during the present century has occurred there only once, viz., in the year 1804.

THE *Moniteur Vinicole* announces the surprising fact that the wine-production of France has not been diminished of late years, in spite of the devastations of the pernicious insect, phylloxera. During the five years, 1862 to 1867 (before the vast spreading of the plague), the annual production averaged 54,747,405 hectolitres. During the five following years (1867 to 1872) it rose to 56,527,129 hectolitres. After 1872, since when the phylloxera invasion began to reach its maximum height, the average annual production has not sunk below 56,000,000 hectolitres. The total of last year's produce amounts to 56,405,363 hectolitres, as against 41,846,748 in 1876.

THE statistics of the German Imperial Telegraph Office for 1877 have just been published. When the Telegraph Office was united with the Post Office there were 1,688 telegraph stations in Germany. At the end of 1877 this number had risen to 3,287.

THOSE desirous of sending objects of natural history from Guatemala (Central America) to the forthcoming Paris Exhibition are requested to communicate with M. A. Boucard, of 55, Great Russell Street, W.C., until the 20th inst. After that date all communications should be sent to the following address:—Legacion de Guatemala, 3, Rue de Copenhague, Paris.

THE experiments on the practical value of the telephone, carried out by the German postal department, show that it is not adapted to supersede the telegraph on lines which are constantly in use. For local purposes and lines less frequently used it will, however, be introduced on a large scale, a large pecuniary saving being effected by the ease in obtaining officials who have not had to master the difficulties of telegraphy. The department has also introduced an apparatus for calling the official at the station to which a message is to be sent, so that an electric battery is now unnecessary for the purpose of summoning attention.

AUSTRALIAN colonists have noticed some strange peculiarities in bees imported from Europe, which, however unpleasant they may be to the agriculturist, are yet of the highest interest to naturalists. It appears that our European bees retain their industrious habits only for the first one or two years, when imported into Australia. While during that period they keep their hives in good order and yield a fair quantity of honey, they gradually cease to collect honey after that time, and soon become entirely barren.

MR. MURRAY has published in a neat little volume, Virchow's address at the German Association last autumn, on the Freedom of Science in the Modern State. We are glad this has been done, as the address is one well worthy the attention of men of science. It was our sense of its importance that induced us some months ago to publish in our columns a verbatim translation of the address, as well as translations of the addresses of Haeckel and Nägeli, on which Virchow's address is to a large extent a criticism and reply.

THE master of the *D. M'B. Park* (British barque), which arrived at West Cowes (I. W.), March 3, from Batavia, reports as follows:—January 29, at 7 A.M., in lat. 4.20 N., long. 21.45 W., saw several submarine volcanoes throwing large columns of water about 100 feet into the air, while the sea was in great commotion, as it is when there is a very strong under-current, the weather at the time being very cloudy, with rain, and nearly calm. The sound was like distant thunder.

VARIOUS theories have been offered of the sense of temperature. In a recent one by M. Hering it is represented that when at a given part of the skin we feel neither heat nor cold, the feeling of temperature at that part is, so to say, at *zero*. The main points of the theory are these: The feeling of temperature depends on the height, for the time being, of the temperature proper (*eigen Temperatur*) of the nervous apparatus of the skin, not on the rise or fall of this temperature (Weber) nor on the intensity and direction of the heat current (Vierordt). Every temperature of the nervous apparatus above the zero point is felt as heat, every one below as cold. The distinctness of the sensation of heat or cold increases with the distance of the temperature proper for the time being, from the zero temperature. The zero temperature is variable within certain limits. Every temperature of the nervous apparatus, felt as warm, causes a displacement of the zero point of the scale of sensation upwards, and every temperature felt as cold causes a displacement downwards. These ideas are developed by M. Hering, in a recent paper to the Vienna Academy.

M. LENGLEN, a physician of Arras, has recently described a remarkable perpetuation of physical traits. A certain M. Gamelon, in the last century, was sex-digital, having two thumbs on each hand and two great toes on each foot. The peculiarity was not noticeable in his son, but in each of the three subsequent generations it has been strongly marked, some of the children at present showing the malformation as distinctly as their great-great-grandfather. M. de Quatrefages has noticed, a few months since, a similar case in the animal kingdom. A six-toed cock having transmitted this peculiarity to his descendants, it has spread to such a degree, that in the district where it occurred the ordinary five-toed variety is no more to be met with.

LIME, strontian, and baryta have recently been obtained in the crystalline state by Dr. Brügelmann, of Düsseldorf (*Ann. der Phys.*, No. 11), by heating their nitrate salts till complete decomposition takes place. In this way are obtained the three oxides in (chiefly) microscopical crystals of the regular system, and exclusively hexahedra. While, however, in the case of strontian and baryta, this interesting fact and new example of isomorphism is recognisable only with aid of the microscope, the lime can be easily obtained in large crystals, observable with the naked eye. Dr. Brügelmann describes his method fully, as also the form and properties of the three crystallised alkaline earths.

IT was pointed out some time ago by M. Herwig, that when strong induction shocks are sent through liquids they do not pass conformably to Ohm's law; there is at first a retardation of the electricities in the electrodes, and the equilibration which at length occurs is somewhat like a discharge, as in the case of a large condenser. The phenomenon has of late been more fully studied by M. Herwig, who describes various interesting experiments with reference to it in the *Annalen der Physik*, No. 12.

M. GASTON PLANTÉ describes at length in the last number of the *Annales de Chimie et Physique*, his newly-discovered method for the engraving of glass, a process which promises to be of widely-extended application. His attention was first directed to this line of investigation by the observation that glass moistened with a solution of ordinary salt was strongly attacked by currents from secondary piles. As perfected, his process consists in

immersing a plate of glass in a shallow basin containing a concentrated solution of potassic nitrate. It is encircled by a platinum wire also covered by the liquid, and connected with the pole of a secondary battery of fifty elements. The other pole consisting likewise of platinum wire covered with an insulator is held in the hand and applied to those parts of the glass where it is designed to engrave. A flash of light is produced by every contact with the electrode, and a mark accompanies each luminous appearance. The depth and fineness of the lines described depend directly on the rapidity with which the electrode is moved, and the fineness of its point.

THE Deutsche Gesellschaft für öffentliche Gesundheitspflege has appointed a commission to co-operate with the government meteorological stations, in endeavouring to obtain the daily publication of the weather observations with probabilities for the following twenty-four hours, according to the American system.

THE additions to the Zoological Society's Gardens during the past week include two Brown Coatis (*Nasua nasica*) from South America, presented by the Hon. C. H. Wynn; a Palm Squirrel (*Sciurus palmarum*) from India, presented by Miss Barclay; two Rock Sparrows (*Petronia stulta*), South European, presented by Mr. D'Arcy Thompson; an Ocelot (*Felis pardalis*), a Red and Yellow Maccaw (*Ara chloroptera*), a Yellow Snake (*Chilobothrus inornatus*) from South America, two Black-capped Bitterns (*Butorides atricapilla*) from Africa, a Four-lined Snake (*Coluber quadrilineatus*) from Egypt, deposited; a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, purchased; a Red Kangaroo (*Macropus rufus*), an Indian Muntjac (*Cervulus muntjac*), born in the Gardens.

EXTENT AND PRINCIPAL ZONE OF THE AURORA BOREALIS

IN the *Wochenschrift für Astronomie*, Herr H. Fritz has recently compared his "Catalogue of Polar Lights," which contains notes of all auroræ which have been observed since 1846, with a publication of Herr A. Moberg, who gives an account of all auroræ observed in Finland during the years 1846 to 1855—some 1,100 in number. The comparison yields some interesting results which are not without importance for the theory of the phenomenon.

It appears that out of 2,035 days of the months from August to April, upon which auroræ were seen and which are entered in Herr Fritz's Catalogue, no less than 1,107 days were auroral days in Finland. Of these 1,107 auroræ 794 were simultaneously visible both in America and Europe, 101 only in Europe, while the remaining 212 were only seen in Finland. During the same period (1846 to 1855) 928 auroræ were seen in Europe or America which were not visible in Finland. All these figures of course refer only to the months from August to April, since during the summer months no phenomena of this kind can be observed in Finland on account of the brightness of the nights. As Herr Moberg's observations were collected from 128 different stations in Finland, we must conclude that only a very small number of auroræ remained unnoticed. We thus arrive at the conclusion that a great number of auroræ cannot have a very widely extended sphere, or that the causes of these phenomena must often be of a very local character (this is confirmed by several observations at high latitudes), while with another part of the phenomena the extension of their sphere or district of simultaneous visibility must be very considerable. The number of auroræ which were seen in Finland only—at least for which up to the present no data of observation elsewhere have been received—is very small (212, or only 19 per cent. of the total number seen in Finland). As the frequency of the phenomena increases—at the time of the maximum—the number of simultaneous observations in Finland and America rises, while the numbers of auroræ seen in Finland and Europe only, or of those exclusively seen in Finland, decrease. This agrees perfectly with the well-known law that with the increase of frequency of polar lights their intensity and sphere of visibility increase also. If we carefully take into account the less prominent phenomena the above proportions would be slightly modified, but most probably they would never prove that on any day when an aurora was visible only in a small district in Europe, another one was simultaneously seen in America. Thus the comparison made by Herr Fritz contradicts Renou's view that the phenomena in America and Europe change periodically.

Of 2,878 days on which auroræ were observed in America during 1826 to 1855, there are 1,065 on which auroræ were also seen in Europe, so that at least every third observation was simultaneous in both parts of the world. For the years during which more exact observations were made, viz., from 1846 to 1855, and again from 1868 to 1872, we find that during the former period out of 1,691 auroras 657 were simultaneously observed both in America and Europe; and during the latter period out of 715 no less than 397, or far more than half the number. If the catalogues were more perfect the number of simultaneous observations would, beyond doubt, be found to be still greater. Some observations made in Scotland give similar results to those dating from Finland, but their publication must at present be delayed, since the American data for comparison are still wanting.

The local occurrence of auroræ does not speak favourably for the hypothesis which places the phenomenon among the cosmical ones. Some ten years ago Herr Fritz published his views with regard to the geographical distribution of auroræ, and constructed a system of lines which he termed Isochasms—*i.e.*, curves of equal frequency of auroræ. The outlines of this system were as follow:—The zone of greatest frequency and intensity of auroræ began near Barrow point (72° north latitude) on the northern coast of America; thence it passed across the great Bear Lake towards Hudson's Bay, crossing the latter at 60° N. lat., passing over Nain, on the coast of Labrador, keeping south of Cape Farewell; its further course was between Iceland and the Far Oer to the vicinity of the North Cape in Norway, and thence into the Arctic Sea. According to the observations then in possession of Herr Fritz, the line passed round Novaya Zemlya and Cape Tsheljuskin, approached the north coast of Asia, in the eastern part of Siberia, in the longitude of Nischni Kolymsk, and thence returned to Barrow Point.

Now after ten years, in spite of the vastly accumulated material of careful observations, there appears no necessity to change Herr Fritz's system of curves in any essential detail; indeed certain parts of the same, which were at first only based on probability and supposition, the part of the principal zone between the north of Norway and Nishni Kolymsk as an instance, we now know with perfect certainty to be correct. Nearly identical, perhaps entirely so, with the line of greatest frequency is the line which marks the limit of visibility of auroræ towards the pole or the equator; since to the north of the line in question the auroræ are only seen in the direction of the equator.

PARIS ACADEMY PRIZES FOR 1878

I. EXTRAORDINARY PRIZES.—Grand prizes in the Mathematical Science.—1. The application of the theory of elliptic transcendants or abelians to the study of algebraic curves. 2. It is known that the great axis of the orbit which a planet describes round the sun is not affected by any secular inequality of the order of the two first powers of the disturbing masses. Examine if there exists in the value of this great axis secular inequalities of the order of the cube of the masses, and, in the case where these inequalities are not rigorously destroyed, give the means of calculating their sum, at least approximately. The prize is a medal of the value of 3,000 francs. 3. Study of the elasticity of crystallised bodies, from the double point of view of experiment and theory. Prize the same as No. 2.

Grand prizes in the Physical Sciences.—Study of the mode of distribution of marine animals on the littoral of France. A medal of 3,000 francs value.

An extraordinary prize of 6,000 francs will be awarded as a recompense for any progress calculated to increase the efficacy of the French naval forces.

II. MECHANICS.—1. The Poncelet prize of a medal of 2,000 francs value, and a complete copy of Poncelet's works, are awarded to the work contributing most to the progress of the mathematical sciences, pure or applied, published in the course of the ten years preceding the judgment of the Academy. 2. A Montyon prize, a medal of 427 francs value, will be awarded to any one who, in the judgment of the Academy, is most deserving, by inventing or improving instruments useful to the progress of agriculture, the mechanical arts, or the sciences. 3. The Plumey prize, a medal of 2,500 francs value, awarded to the

author of an improvement of steam-engines, or of any other invention contributing most to the progress of steam navigation. 4. The Bordin prize, a medal of 3,000 francs value, will be awarded for a satisfactory solution of the following problem:—To find the means of destroying, or at least seriously diminishing, the annoyance and the dangers arising from the products of combustion issuing from the chimneys of locomotive engines, steamships, and manufactories near towns.

III. ASTRONOMY.—1. The Lalande prize, a medal of 542 francs value, will be awarded to the person who shall have made the most interesting observation, or to the memoir or the work most contributing to the progress of astronomy. 2. The Damoiseau prize, a medal of 5,000 francs value, will be awarded (in 1879) for a solution of the following question:—Revise the theory of the satellites of Jupiter; discuss the observations, and deduce from them the constants they contain, and particularly that which furnishes a direct determination of the rate of light; finally, construct special tables for each satellite. 3. The Valz prize, the proceeds of a sum of 10,000 francs, will be awarded for the most interesting astronomical observation made during the year.

IV. PHYSICS.—The Bordin prize, a medal of 3,000 francs value, will be awarded for a solution to the following:—Various formulæ have been proposed to replace Ampère's law on the action of the elements of currents; discuss these various formulæ and the reasons which may be alleged for giving the preference to one of them. 2. Three Lacaize prizes of 10,000 francs each will be awarded (in 1879) to the works or memoirs which have contributed most to the progress of physiology, physics, or chemistry.

V. CHEMISTRY.—The Jecker prize of 10,000 francs will be awarded to the researches which the Academy judges best calculated to accelerate the progress of organic chemistry.

VI. BOTANY.—1. The Barbier prize of 2,000 francs will be awarded to anyone who makes a valuable discovery in surgery, medicine, pharmacy, or botany, in connection with the art of healing. 2. The Alhumbert prize, a medal of 2,500 francs value; the subject of this prize is a study of the mode of nutrition of fungi. 3. The Desmazières prize of 1,600 francs will be awarded to the best or most useful writing on the whole or part of cryptogamy published during the year. 4. The Shore prize of 200 francs will be awarded to the author of the best memoir on the cellular cryptogams of Europe, or on the habits or anatomy of a European species of insect. 5. The Bordin prize of 3,000 francs has for its subject the following:—Explain by direct observations and by experiments the influence which the medium exercises on the structure of plant organs (roots, stem, leaves); study the variations which terrestrial plants undergo when raised in water and those which aquatic plants undergo when forced to live in air. Explain by direct experiments the special forms of several species of maritime flora.

In medicine and surgery the Bréant prize of 100,000 francs for a cure for Asiatic cholera still stands.

One or more Montyon prizes are awarded to works or discoveries which show the means of rendering an art or occupation less insalubrious.

The competition closes on June 1 each year. Works sent in are not returned, and the conditions as to the use of mottoes, concealment of names, &c., usual to such competitions are required.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

SCIENCE IN SCHOOLS.—Sir John Lubbock has given notice on an early day to move in the House of Commons that it would be desirable to modify the Code of Education by adding elementary natural science to the subjects mentioned in Article 19, c. 1.

BRESLAU.—The number in attendance at the University during the present winter is 1,253, divided as follows among the faculties:—Theological, 101; legal, 432; medical, 168; philosophical, 552. The University possesses one of the most valuable libraries in Germany, numbering over 400,000 volumes and several thousand valuable manuscripts.

BERN AND ZURICH.—The former University is attended at present by 410 students, the latter by 318. Each University includes in its list nineteen female students, most of whom are preparing for medical examinations.

LIBRARIES OF GERMAN AND AUSTRIAN UNIVERSITIES.—Most of the German States place annually considerable sums at the disposal of the University libraries. Bavaria gives her universities each 1,000*l.* for this purpose; Saxony grants 1,200*l.* to Leipzig; while in Prussia the sums vary from 600*l.* for Greifswald to 2,000*l.* for Göttingen. In Austria, although the existence of so many different languages in the empire makes special demands on the university libraries, the Government assistance has hitherto been exceedingly limited. We notice, however, that in a late session of the Reichstag a new policy has been adopted, and that the annual grants have been raised to 1,500*l.* for the Vienna library, 1,000*l.* for that at Prague, and 800*l.* for those in the other universities.

ST. PETERSBURG.—On January 1, 1878, the University at St. Petersburg numbered 1,425 students, thirty-seven more than last year. One-seventh are in the department of History and Philology, three-sevenths in Natural Sciences and Mathematics, three-sevenths in Law, and one-forty-seventh in Asiatic languages. The number of professors is ninety-three. The students are mostly very poor, and the pecuniary help given to them by the University amounted during the year to the sum of 12,000*l.*; besides which, a private society of former students paid the fees for eighty-one persons.

KIEFF.—The University celebrated, during the past month, the fifty-ninth year of its existence. Although so young it is well equipped with all the necessary adjuncts of a university, and its medical faculty is regarded as the first in Russia. The number of students at present is 773, an increase of 160 on the previous year. The majority are in the medical faculty. As in the other Russian universities, the students are recruited principally from the poorer classes, 203 being freed from the payment of lecture-fees, and 123 in addition receiving stipends amounting in the total to 36,000 roubles. A high school for ladies is at last to be opened at the University.

SCIENTIFIC SERIALS

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. x. Fasc. xix.—Reduction of chlorates to chlorides without intervention of the so-called nascent state of hydrogen (second part), by M. Tommasi.—On the cooling of pulverulent metallic solids, by M. Cantoni.—On temperature in relation to actual energy and the state of aggregation, by M. Grassi.—Measurement of the resistance and graduation of any galvanometer, by M. Grassi.—A school experiment and means of evaporating rapidly large quantities of liquid, by M. Brugnatelli.

Fasc. xx.—Other experiments on the evaporation of a liquid, by M. Cantoni.—Hypertrophy and hyperplasia, by M. Sangalli.—On the first and most recent appearance in Lombardy of the Beccafico of Provence.

Kosmos, November, 1877.—On the relation of Greek nature-philosophy to modern natural science, by Prof. F. Schultze. Part 1, on the Ionic physiologists and the Pythagoreans.—On a mathematical law applicable to the theory of mutation, by J. Delbœuf.—On the variations of size of coloured floral envelopes, and their effect on the natural selection of flowers, by Hermann Müller.—A turning point in the early history of the human race, by J. H. Becker. Part 1, on the state of things preceding the turning point (before the discovery and use of fire).

December, 1877.—F. Schultze, on the relation of Greek natural philosophy to modern natural science, part 2, discussing Heraklitus and the Eleatic school.—W. Preyer, on the nature of life.—Fritz Müller, observations on Brazilian butterflies, part 3, dealing with the evolution of the Maracuja butterflies, and the phenomena presented by their larvæ, pupæ, and adult forms.—A. Maurer, on the origin of articulate sounds.—J. H. Becker, on the separation and reunion of races.—The number also contains a review of Mr. Darwin's work on the different forms of flowers, by Hermann Müller.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, February 6.—Prof. P. M. Duncan, F.R.S., president, in the chair.—James Adey Birds, Rev. George E. Comerford-Casey, M.A., Lieut.-Col. H. H. Godwin-Austen, Sir Willoughby Jones, Bart., and Henry Richard Ladell, M.A., were elected Fellows of the Society.—The following communi-

cations were read :—On some foraminifera from pleistocene beds in Ischia, by M. Ernest Vanden Broeck. Preceded by some geological remarks by A. W. Waters, F.G.S.—On the influence of the advent of a higher form of life in modifying the structure of an older and lower form, by Prof. Owen, C.B., F.R.S. In this paper the author, after referring to the general question of the modification of the structure of organic forms produced by the action of external influences, indicated that, in connection with this, changes in the nature of the prey of carnivorous animals ought to be taken into consideration. He inferred that cold-blooded aquatic animals formed a much greater proportion of the food of mesozoic than of neozoic crocodiles, and pointed out as connected therewith the well-marked distinction between the amphicœlian and procœlian type of vertebræ respectively characteristic of the two groups. The procœlian character of the trunk-vertebræ better adapts that part of the body to be sustained and moved in air, and may be connected with the incoming in tertiary times of mammalian prey inducing the crocodiles to rush on shore. The mesozoic crocodiles were encased in a much stronger and more complete dermal armour than their successors, doubtless for their protection from the great ichthyosaurs, pliosaurs, &c., which co-existed with them; but as these passed away at the close of the secondary epoch, the armour of the procœlian crocodiles has become more scanty, and the diminution of weight and rigidity thus caused would favour progression in air, and the rapidity of movement required for capturing mammalian prey on land. The difference in the position of the palato-nares, and in other related gular and palatal structures, between the mesozoic and neozoic crocodiles is apparently connected with the power possessed by the latter of holding submerged a powerful mammal without permitting the access of water to the posterior nostrils and windpipe of the crocodile; and hence the author is inclined to ascribe a fish-diet even to those massive-jawed crocodiles from the Purbeck (such as *Goniopholis crassidens* and *simus*), which in some respects might seem fitted to grapple with large and active mammals. The small size of the upper temporal apertures in tertiary and existing crocodiles is regarded by the author as a further proof in the same direction; these apertures are reduced by the progressive increase of the osseous roof of the temporal vacuities, which again is correlated with increase in the bulk and power of the temporal muscles, the main agents in biting and holding. The differences in the length and strength of the jaw, as a rule, testify in the same direction. Further, the fore limbs in mesozoic crocodiles are shorter than in neozoic species, indicating that the former were more strictly aquatic in their habits; the forelimbs in all crocodiles being closely applied to the body during rapid swimming, and small limbs being less obstructive than larger ones. On the other hand, they would be less efficient as a means of progression on land, and hence it may be inferred that the advent in tertiary times of mammals frequenting the water-side, tempting the crocodiles to make a rush upon the land to seize such passing prey, would lead to such strenuous action of the fore-limbs as would account for the increased size and power of those organs in the neozoic species. The author concluded with some remarks upon the influence of the above considerations upon our views as to the generic divisions of crocodiles.—Notes on a supposed crocodilian jaw from the coral rag of Weymouth, by E. Tully Newton, F.G.S., of H.M. Geological Survey. In this paper the author describes what he believes to be a fragment of a lower jaw of a crocodilian, obtained from a greyish brown sandy grit, probably belonging to bed 3 of Messrs. Blake and Hudleston's Sandford-Castle section.—Note on two skulls from the Wealden and Purbeck formations indicating a new sub-group of crocodilia, by J. W. Hulke, F.R.S., F.G.S. The author described a crocodilian skull obtained by Mr. H. Willett, F.G.S., from the Hastings sands near Cuckfield, in Sussex, and identified by that gentleman with *Goniopholis crassidens*, Owen; and another from the Purbecks near Swanage, in the collection of the British Museum, which he further compared with a third specimen from Brook, in the Isle of Wight.

February 15.—Annual General Meeting.—Prof. P. M. Duncan, F.R.S., president, in the chair.—The Secretaries read the Reports of the Council and of the Library and Museum Committee for the year 1877. The Society was described as in an exceedingly prosperous condition, and the income of the year was stated to have considerably exceeded the expenditure. The number of Fellows elected was fully up to the average. The Report further announced the receipt of a bequest of 500*l.* under the will of the late Mr. C. Lambert, which sum, with 150*l.* of the surplus of income, had been invested in consols for the benefit of the Society.—The Wollaston Gold Medal was presented to Dr. Thos. Wright, F.R.S., for his varied palæontological researches.—The President then presented the balance of the proceeds of the Wollaston Donation Fund to Mr. W. J. Sollas, M.A., F.G.S., in recognition of his careful morphological and mineralogical studies upon the fossil Spongida.—The President next handed the Murchison Medal to Mr. Warington W. Smyth for transmission to Dr. Hanns Bruno Geinitz, of Dresden for his researches in the geology and palæontology of the palæozoic and cretaceous formations of Saxony; and the balance of the proceeds of the Murchison Geological Fund to Mr. H. Hicks, F.G.S., for transmission to Mr. Charles Lapworth, F.G.S., for a most important communication upon the Silurian rocks of the South of Scotland, and the graptolites contained in them.—The President next handed to Mr. J. W. Hulke, F.R.S., the Lyell Medal and part of the Lyell Fund for transmission to Mr. George Busk, F.R.S., as a token of the Council's appreciation of his merits as a palæontologist.—The balance of the proceeds of the Lyell Fund was handed to Dr. Oldham, F.R.S., F.G.S., for transmission to Dr. W. Waagen, of Vienna, and who was lately on the Geological Survey of the East Indies. Dr. Waagen's labours in India have commended themselves to the Council on account of their great merit and interest.—The President then proceeded to read his anniversary address, in which he dwelt in considerable detail upon the influence of advanced morphological and zoological investigations upon our palæontological ideas and upon the geological inferences founded upon them.—The ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year :—President, H. C. Sorby, F.R.S. Vice-Presidents : R. Etheridge, F.R.S., John Evans, F.R.S., Prof. J. Prestwich, F.R.S., Prof. A. C. Ramsay, F.R.S. Secretaries : Prof. T. G. Bonney, M.A., Prof. J. W. Judd, F.R.S. Foreign Secretary : Warington W. Smyth, F.R.S. Treasurer : J. Gwyn Jeffreys, F.R.S. Council : H. Bauerman, Prof. T. G. Bonney, M.A., Prof. W. Boyd Dawkins, F.R.S., Prof. P. Martin Duncan, F.R.S., R. Etheridge, F.R.S., John Evans, F.R.S., Henry Hicks, W. H. Hudleston, M.A., Prof. T. McKenny Hughes, M.A., J. W. Hulke, F.R.S., J. Gwyn Jeffreys, F.R.S., Prof. T. Rupert Jones, F.R.S., Prof. J. W. Judd, F.R.S., J. Morris, J. A. Phillips, Prof. J. Prestwich, F.R.S., F. G. H. Price, Prof. A. C. Ramsay, F.R.S., R. H. Scott, F.R.S., Warington W. Smyth, F.R.S., H. C. Sorby, F.R.S., Admiral T. A. B. Spratt, C.B., F.R.S., Rev. T. Wiltshire, F.L.S.

Zoological Society, February 19.—Prof. Mivart, F.R.S., vice-president, in the chair.—The Secretary exhibited the skin of a fine adult cassowary, which had been obtained at Wandammen, on the eastern coast of the Bay of Geelvink, New Guinea, and had just been acquired by the British Museum. The species to which it belonged was believed to be undescribed, and was proposed to be called *C. altijugus*, from its peculiar high-peaked helmet.—Mr. P. Geddes read a memoir on the mechanism of the odontophore in certain mollusca. In this paper the view of Cuvier—that the movements of the radula depend upon those of the underlying cartilages—was substantially revived, arguments being adduced against the more recent theory of Prof. Huxley, that it runs like a chain-saw, the cartilages merely forming a pulley-block. The use of bacteria as food by *Lymnæus* was also described by the author in this paper.—Prof. A. H. Garrod, F.R.S., read some notes on the anatomy of *Tolypeutes tricinctus*, and gave remarks on other *Dasypodidæ*. A new form of *Tolypeutes*, allied to *T. conurus*, was proposed to be called *T. muriei*.—A communication was read from Mr. J. H. Gurney, F.Z.S., containing notes on a specimen of *Polyborus*, lately living in the Society's Gardens.—A communication was read from Mr. D. G. Elliott, F.Z.S., containing the results of his study of the *Pteroclidæ*, or family of sand grouse. Nine species of *Pterocles* and two of *Syrrhaptes* were recognised as composing the family.—Messrs. F. Du Cane Godman and Osbert Salvin gave descriptions of new species of diurnal lepidoptera from Central America.—A communication was read from Mr. R. Bowdler Sharpe, giving an account of a small collection of birds from the Ellice Islands.—Mr. Edward R. Alston read a note on the dentition of *Cuscus*.—A communication was read from Mr. T. F. Cheeseman, containing the description of three new species of Opisthobranchiate mollusca from New Zealand.—Dr. F. Day communicated some remarks on the paper read by Mr. Whitmee

at the last meeting of the Society, on the manifestations of fear and anger by fishes.—A communication was read from the Marquis of Tweeddale, F.R.S., containing an account of a collection of birds made by Mr. A. H. Everett, in the Island of Negros, Philippines.—A second communication from the Marquis of Tweeddale contained the description of a new species of the genus Buceros, proposed to be called *B. semigaleatus*, from the Island of Leyle, Philippines.

Mineralogical Society, February 19.—Mr. H. C. Sorby, F.R.S., president, in the chair.—The president read a valuable and important paper on the determination of the minerals in thin sections of rocks by means of their refractive indices. In this paper he showed how the refractive indices might be determined with great accuracy in sections less than $\frac{1}{100}$ of an inch in thickness, cut for ordinary microscopic purposes.—The Rev. T. G. Bonney then read a paper on some specimens of Gabbro from the Pennine Alps, in which he pointed out the great changes which these rocks had undergone, and their similarity to the rocks of the Lizard district in Cornwall.—Mr. J. H. Collins read a paper on the classification of minerals, in which he advocated a primary chemical and a secondary mixed system of classification. This paper elicited an interesting discussion. Specimens in illustration of their papers were exhibited by the president and by the Rev. T. G. Bonney.—Dr. Foster exhibited specimens of carbonate of bismuth, and other minerals from new Cornish localities.

Photographic Society, February 12.—Annual Meeting.—James Glaisher, F.R.S., president, in the chair.—A silver progress medal was awarded to Capt. Abney, R.E., F.R.S., for having made the greatest advance in the science of photography during the past year.—Capt Abney exhibited a very large positive photograph taken from one of Janssen's negatives of the sun, which were taken by a five-inch telescopic objective of about seven feet focal length, corrected for the chemical, but not for the visual rays.—Mr. Edward Viles exhibited the microphotographic apparatus by which the large photograph (recently seen at the exhibition) of the proboscis of the blow-fly enlarged 200 diameters, was taken, the mechanism and use of the heliostat being minutely described.—Capt. Abney also exhibited and described two other forms of heliostats which he had used.

PARIS

Academy of Sciences, February 25.—M. Fizeau in the chair.—The President announced the opening of a subscription for a statue to M. Leverrier. The following papers were read:—On the carburation of nickel by the process of cementation, by M. Boussingault. Though combining with carbon, nickel does not acquire, like iron, the properties found in steel; nor is the cemented nickel rendered less oxidable. (M. Becquerel is examining its magnetic properties.)—On a new product of oxidation of lead, and on some phenomena of dissociation, by M. Debray. Sesquioxide of lead is transformed, gradually at 350°, and rapidly at 440° into minium, which is not susceptible of being hyperoxygenated in air, or even in pure oxygen. It cannot be said that any compound formed directly will necessarily undergo a limited decomposition at a given temperature.—Imitation of the characteristic cupules and erosions found on the surface of meteorites in an industrial operation, by action of a rapid current of air on incandescent stones, by M. Daubrée. In a new mode of manufacture of Portland cement, the stones raised to white heat are subjected to a current of cold air; the specimen (furnished by M. Hauenschild) showed a surface very like that of meteorites.—Note on a new *brochure* of M. Hirn on music and acoustics, by M. Faye.—On the recent communication of M. Broun, and a note of Mr. Jenkins relating to sun-spots and terrestrial magnetism, by M. Faye.—On telephones with battery, by M. Du Moncel. The author hopefully calls attention to MM. Pollard and Garnier's attempts to strengthen the sound; the sending telephone being on Edison's graphite system, while the receiver is a Bell telephone connected to the induced wire of a Ruhmkorff coil, the battery currents being passed through the primary wire. With pretty strong currents words can be heard 50 or 60 ctm. from the mouth of the telephone, and musical sounds several metres off.—The vibrations of matter and the waves of the ether in ebullition, by M. Favé.—Report on a memoir of M. Haton de la Goupillière.—On the lines generated in movement of a plane figure.—On some consequences of the constitution of the solar spectrum, by M. Cornu. If the sun's outer layer contain, like aerolites, a large amount of iron vapour, this metal probably has an appreciable action on our terrestrial magnetic phenomena. The central part of the earth seems to be formed of much denser materials than the crust, probably metallic matter; and the probable common origin of bodies of the solar system seems to point to iron being largely present, which would explain the earth's action on the magnetic needle. Again, the solar protuberances may correspond to illumination by induction (large magnetic masses being in rapid motion) of rarefied gaseous masses—an illumination easily produced in our laboratories by means of the weakest mechanical actions.—On differential actions of the first order and the first degree, by M. Darboux.—On the temporary variation of permanent magnetism, by M. Gaugain.—When a system (tube and core, or even full bar) magnetised at ordinary temperature is raised to 300° or 400°, the weakening of the magnetism is not exclusively due to a part of this magnetism being destroyed; it arises in part from the *inverse* magnetism being developed in the tube under influence of heat.—On the action of fluoride of boron on organic matters, by M. Landolph.—Transformation of bromated hydrocarbons of the series of ethylene into bromides of acids of the fatty series, by simple addition of oxygen, by M. Demole.—Analysis of the sulphurous waters of Aix, in Savoy, and of Marlioz, by M. Willm.—Action of oxygen on anatomical elements, by M. Bert. These elements are nourished by reducing the oxyhæmoglobic combination (and similarly to the butyric ferment); but if their substance be penetrated artificially with chemically free dissolved oxygen, they become incapable of taking oxygen from the matter which furnished it before, and die by a kind of asphyxia; in a word they are *anærobies*.—On local variations of the pulse in the forearm of man, by M. Mosso. He experiments with a *hydrosphygmograph*, which is a modification of his plethysmograph. The effects during intellectual effort, sleep, &c., are described.—On lactic fermentation of sugar of milk, by M. Richet. It seems that the gastric juice, by its dissolving action on caseine and perhaps another action yet unknown, gives lactic fermentation a surprising activity and rapidity.—Classification of Cestoïdes, by M. Perrier.

VIENNA

Imperial Academy of Sciences, January 3.—On the velocity of propagation of spark-waves, by MM. Mach, Tumlirz, and Kögler.—On orthogonal substitutions and some related to them, by M. Igel.—On ballooning, by M. Ettalp.—Three experiments with the telephone, by M. Sacher.

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