THURSDAY, JUNE 27, 1878

HENFREY'S BOTANY

An Elementary Course of Botany, Structural, Physiological, and Systematic. By Arthur Henfrey, F.R.S. Third Edition by Maxwell T. Masters, M.D., F.R.S., &c. Illustrated by 600 woodcuts. (London: Van Voorst, 1878.)

IN reviewing a work of this kind, by acknowledged masters of science, the question naturally comes to the front: For what special class of students is it intended? and when this has been settled, a second question: Is the plan which has been adopted the best conceivable for the purpose? The first of these questions appears to be answered in the preface, by the editor's quotation and adoption of Prof. Henfrey's remarks, written in 1857, where he makes special reference to the needs of medical students, who seldom devote to the study of botany more than the summer term of their first session. As to the mode, Dr. Masters also refers with approval to Henfrey's plan of keeping the anatomical and physiological departments of the subject very much in the background, and training the student first of all in morphology and the rudiments of classification; on the ground that by this plan the evil is avoided of "directing the attention of the student to a series of isolated facts and abstract propositions," and of "loading the memory with second-hand information, of no use whatever outside the walls of the examination-room, and indeed of but little service in practical examinations." We may venture to question whether the plan adopted in this work is altogether the best for securing this desirable result, whether, for example, the pages devoted to phyllotaxis[1] do not include a number of "isolated facts and abstract propositions," and whether a longer or shorter description of the characters of considerably over 200 natural orders of flowering plants—when those of twenty-five or thirty are all that would be likely to be of any use to the medical student—may not fairly be open to the charge of "loading the memory with second-hand information;" since it is very few, even of the most experienced botanists, whose personal observation has embraced so wide a range. It is true that this portion may be skipped by the beginner; but then, why include it in a work specially intended for beginners? Fortunately, the day of "Complete Guides to Knowledge" has altogether gone by. The teacher no longer calculates on getting the outlines of every conceivable science within a single pair of boards. This tendency must advance still further, and our text-books must gradually divide themselves into two classes:—one giving primary instruction in the outlines of the entire science; the other, for the more advanced student, entering into the fullest details of special branches. In the science of botany we have numerous admirable text-books and primers which might be included in the first category; in the second, English literature is not yet so rich as French or German. The book before us seems to occupy an intermediate position between the two; it is needlessly bulky and expensive for the medical student who looks to nothing but keeping himself abreast of a three-months' course of lectures; it will not suffice for one who aims at becoming a scientific botanist.

After this criticism on the plan of the work—a point on which it is inevitable that different experiences and different modes of looking at the subject will lead to different conclusions—the manner in which the plan is carried out claims all but unqualified approval. In particular is this edition a great advance, in both completeness and accuracy, on that which preceded it; and the editor may be congratulated on having got together a larger amount of trustworthy and accurate information than can be found in any similar work of the same size. Here and there the terminology is hardly abreast of that of the most approved recent writers, as where the term "perisperm" is still used as synonymous with "albumen," to signify any nutritious tissue intermediate in the ripe seed between the testa and the embryo; instead of being confined to the case where this tissue is developed out of that of the nucleus, as in the Nymphæaceæ, Piperaceæ, and Cannaceæ, in contrast to the much more common "endosperm" which originates primarily within the embryo-sac. But it is remarkable how very few instances there are of defects of this kind, so liable to occur in new editions of old standard works. We notice with satisfaction the tendency to anglicise certain terms, the foreign aspect of which is repulsive to the beginner. Why should not "epiderm" and "parenchyme" become universal, instead of "epidermis" and "parenchyma"?

It is difficult to decide which part of the work is in itself the most satisfactory, that on morphology, on classification, or on physiology, each of these constituting a clear and admirable treatise. The plan advocated in some text-books, of giving the authority of the actual observer for every statement, is not adopted here, and we think wisely. The beginner must take facts which he is not able to verify for himself on the authority of his immediate teacher; it is only when the beginner becomes a student that he has any occasion to trace every statement to its source, or is able to form any judgment on the relative value of different authorities. The advanced text-book of our second category should, therefore, be copious in references; the primer is better without them.

In the department relating to the classification of Cryptogams, Dr. Masters has had the valuable assistance of Mr. George Murray, of the British Museum; and this portion is enriched with a large amount of new and excellent matter. We see, however, here some of the inherent defects of a triple authorship, in the occasional want of harmony of different portions. Thus, while in the general introduction to classification the latest arrangement, that of Sachs's "Lehrbuch," fourth edition,[1] is given, the system actually adopted is substantially that of the second edition of Henfrey's book; Algæ and Fungi are still maintained as separate groups, and the former are divided into Characeæ, Rhodospermeæ,

[1] Evidently by an error of the press, the continued fraction of which the most common angles of divergence are successive convergents, is given as $\frac{1}{2}+\frac{1}{1}+\frac{1}{1}$, &c., instead of $\cfrac{1}{2+\cfrac{1}{1+1}}$, &c., a correction needful to render the sentence intelligible to the student.

[1] Sachs is, however, erroneously credited with locating Eugleneæ unde Protophyta. He has never, as far as we are aware, claimed for *Euglena* a position even in the vegetable kingdom

Fucaceæ, Phæosporeæ, Confervoideæ, and Diatomaceæ - an arrangement which will scarcely bear the light of modern science. The beginner will be likely to be set wrong by finding the term "reproductive organs" sometimes used for the organs between which a sexual process takes place, sometimes for the result of such process; and by reading that Algæ are reproduced by spores which are the result of the action of the antherozoids, while under the head of Fucaceæ the spores are the unfertilised germ-cells, and elsewhere the term appears to be confined to non-sexual reproductive cells which directly reproduce a plant resembling the parent. But these defects do not seriously detract from the value of the work.

Altogether those who want a thorough grounding in the elements of botany, as well as to be taken a little beyond the threshold in the various avenues which open out to the view of the student, will find a very useful and trustworthy guide in the last edition of this old standard.

ALFRED W. BENNETT

PAYEN'S INDUSTRIAL CHEMISTRY

Industrial Chemistry; a Manual for Use in Technical Colleges and Schools and for Manufactures. Edited by B. H. Paul, Ph.D. (London: Longmans, 1878.)

DR. PAUL has unquestionably rendered some service to the cause of chemical technology in this country by his translation of Payen's well-known work; nevertheless we think the service would have been still greater had he essayed to present us with an entirely original production. The fact is the translation has been made from a translation; it comes to us from the German through Stohmann and Engler's edition. As a consequence we miss much of what is good in Payen, whilst some things that are bad—notably faults in arrangement and inaccuracies of statement—remain. One is reminded of Macaulay's assertion concerning Johnson's Dictionary, which has been so altered by editors that its author would hardly recognise it. Whenever Dr. Paul is on his own ground he is excellent; the supplementary chapters on the chemistry of the metals, for example, are all that could be desired in such a work. The metallurgical portions, more particularly of the more important metals, are especially well done; we question if our language can show anything better on the subjects as regards clearness and conciseness and accuracy than the accounts of the operations involved in the extraction of lead, silver, and iron. But when the editor has to trust to French and German descriptions of technical processes errors crop up. For example, by far the greater portion of the phosphorus which the world requires is made near Birmingham and in Lyons, but neither of the two establishments which thus practically enjoy the monopoly of the manufacture carries out Nicolas and Pelletier's process as described in this work. Britain also furnishes practically all the bichrome of commerce, but the method described on p. 523 is not an accurate description of the present mode of production. The time-honoured cut on p. 181 no longer represents the method by which iodine is manufactured; nor is sulphur obtained by distillation from the traditional pots sacred to the memory of Morgiana and the Forty Thieves, which almost every compiler of an English text-book has sedulously copied. Saxony produces more than 90 per cent. of the bismuth which is found in commerce, but the liquation process described on p. 505 is no longer in use there. The article on "Friction Matches" is, also, scarcely up to date; the old operation of sulphuration is described in detail as if it were an essential feature in the manufacture; the reader is, indeed, told that the splints are now often dipped in stearin or paraffin, but he would certainly infer from the description that sulphur is generally employed; whereas it is only to meet the demands of lamplighters and sailors who specially need a match less easily extinguished by the wind than the ordinary varieties that a very few establishments continue to use sulphur. The composition of the inflammable paste used in France and Germany may, possibly, be represented by some or all of the eight formulæ given on p. 159, but the "compo" of the English manufacturer is altogether different from these. It is certainly remarkable considering the widespread use of lucifer matches, that so little should be known of their mode of manufacture; it takes quite as many persons to make a match as a pin, and the details of the making are equally interesting.

In the portions treating of pure chemistry inaccuracies are unfortunately scarcely less frequent. We willingly pardon the statement that "hydrogen is an elementary substance known in the free state only as a gas which has not yet been condensed by the greatest cold and pressure combined," even when the book makes its appearance several months after the great triumphs of our continental brethren; but the results of Pebal's work on chlorine peroxide ought certainly by this time to be part of the general stock of chemical knowledge. The statement that bromine solidifies at $-7{\cdot}3$ is probably based on Pierre's inaccurate observation made more than thirty years since: Baumhauer has shown that the true freezing-point of this liquid is about $-24^{\circ}{\cdot}5$. The commendatory statement that "the bromine obtained from Stassfurt has the advantage over all other kinds of commercial bromine, that it is entirely free from iodine" (p. 179), is scarcely just to our own product: the bromine turned out by the Scotch makers actually merits this reputation, whereas there is evidence that the German product, to say the least, has not always deserved it. A distinguished German chemist, in studying the action of bromine on ethylbenzene, was, in fact, led astray by the use of the Stassfurt product, which he assumed to be pure: it was subsequently shown that the bromine used by him contained iodine, and the interesting fact was elicited that the action of this iodised bromine on the hydrocarbon is entirely different from that of the pure substance. The statement of Wollaston that our atmosphere does not extend beyond a height of forty-five miles above the sea-level (p. 54) is scarcely in conformity with current opinion: the observations of Herschel and of Secchi have certainly disproved the assertion as regards this particular limit, whilst the reasoning of Clausius has rendered it highly probable that in reality no limit exists.

A few more errors of commission and omission might be cited, but as it is very far from our desire to disparage a work which, by judicious revision, might fairly claim a very high place in our chemical literature, it is hardly necessary to point them out at length, as a second edition will certainly see the greater number corrected. The book unquestionably supplies a need: it attempts to do for industrial chemistry what Mr. Watts's well-known work does for the theoretical part of the science, and we can wish it no higher measure of success than that it should meet with the favour which that work so deservedly enjoys. T.

OUR BOOK SHELF

Annual Report of the Superintendent of Government Farms. (Madras, 1877.)

THIS report of Mr. W. R. Robertson is one of great value; it comprises an account of the present state of native agriculture in the district of Coimbatore, and a statement of the work carried out at the experimental farm at Sydapet.

The information respecting native agriculture was obtained during a three months' tour of inspection. The general condition of the country is clearly most deplorable, and unless improved methods of farming are adopted there is apparently nothing but starvation and ruin before the majority of the ryots. The land irrigated from rivers and tanks forms about 1-25th of the area under cultivation; this land receives scarcely any manure save that supplied by the water; it nevertheless maintains good crops, and its money value is 20—25 times greater than that of land unirrigated. Mr. Robertson complains of the great waste of water: an ordinary crop of paddy will receive during its growth about twelve feet of water. If the crops were manured, far less water would suffice. A still greater saving would be effected by growing crops requiring less water; four or five acres of wheat or maize could be produced with the water required for one acre of paddy. Irrigation by means of wells is employed to some extent; the wells being private property, the water is used with far greater economy than is the case with river irrigation. Mr. Robertson strongly recommends an improved form of water-lift known as the "double mhote;" by this a single bullock can raise as much water as, on the native plan, is accomplished by four bullocks. Facilities for sinking wells should also, he thinks, be increased.

The unirrigated land has of late years very considerably decreased in fertility, and the number of cattle per acre is now only about one-half the number maintained in 1838. "The curse of Indian agriculture" is the employment of cattle manure as fuel, and this custom increases as the jungle is destroyed and brought under cultivation. The author strongly recommends the compulsory planting of fuel trees throughout the country; these would improve the climate as well as furnish the much-needed fuel. A striking feature of the unirrigated land is the entire absence of weeds, a true indication of the poverty of the soil. The greater part of this land is never manured, and is cultivated chiefly for grain crops, *Penicillaria spicata*, *Sorghum vulgare*, and *Eleusine coracana;* fodder crops and pasture are rarely met with. Were fodder crops more largely grown, the live stock increased in proportion, and the cattle manure all returned to the land, a great increase in fertility would be effected. The addition of organic manures to the soil, or the ploughing in of green crops, would also considerably increase the power of the soil to retain moisture, humus being of all the ingredients of the soil that which possesses the greatest water-holding power. Artificial manures are never employed: saltpetre may be purchased at a low price, but it is all exported, and never applied to the land.

It is pleasant to find, towards the conclusion of the report, that a School of Agriculture has lately been opened at Sydapet. Now that the causes of the agricultural depression have been clearly pointed out, we may hope that active steps will be taken to provide a remedy.

R. WARINGTON

LETTERS TO THE EDITOR

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

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

The Size of the Indian Tiger

IN a book recently published entitled "Thirteen Years Among the Wild Beasts of India," by Mr. G. P. Sanderson, of Mysore, at pages 272, 273, the following remarks occur regarding the size of the tiger, and in reference to certain measurements of that animal given in a small volume entitled "The Royal Tiger of Bengal: his Life and Death," published in 1875.

The author (Mr. Sanderson) says,—"Regarding the size of the tiger, once a much disputed point, all careful observers are, I believe, agreed in accepting Dr. Jerdon's view ('Mammals of India') as thoroughly correct. He says, 'The average size of a full-grown male tiger is from 9 to 9½ feet,' but I fancy that there is little doubt that occasionally tigers are killed 10 feet in length, and perhaps a few inches over that; but the stories of tigers 11 feet and 12 feet in length, so often heard and repeated, certainly require confirmation, and I have not myself seen an authentic account of a tiger that measured more than 10 feet and two or three inches. I know," continues Mr. Sanderson, "two noted Bengal sportsmen who can each count the tigers slain by them by hundreds whose opinions entirely corroborate Jerdon. My own experience can only produce a tiger of 9 feet 6 inches and a tigress of 8 feet 4 inches as my largest. Of course writers start up now and again, as the author of the 'Royal Tiger of Bengal' did two years ago, and give us something like the following:—'The full grown male Indian tiger may be said to be from 9 to 12 feet or 12 feet 2 inches, the tigress from 8 to 10 feet, or perhaps in very rare instances 11 feet in length.' It is only fair to the author to state, however, that in the next paragraph he looks with doubt upon Buffon's tiger of 15 feet, and would only with greater hesitation accept the recorded statement that Hyder Ally presented a tiger to the Nawab of Arcot that measured 18 feet.

A portion only of the paragraph in my book is quoted; the most important, the first part, being omitted; it is as follows:—"The statements as to the length they (tigers) attain are conflicting, and errors are apt to arise from measurements taken from the skin after it is stretched, when it may be 10 or 12 inches longer than before removal from the body. The tiger should be measured from the nose to the tip of the tail as he lies dead, before the skin is removed. *One that is 10 feet by this measurement is large, and the full-grown male does not often exceed this, though no doubt larger individuals (males) are occasionally seen; and I have been informed by Indian sportmen of reliability that they have seen or killed tigers over 12 feet in length.*"

This account of the size of the tiger really, therefore, substantially agrees with Dr. Jerdon's, except that he says, "The stories of tigers of 11 feet and 12 feet in length, so often heard and repeated, certainly require confirmation." This confirmation is supplied. The following examples may be adduced:—

Lieut.-Col. G. Boileau killed a tiger at Muteara, in Oude, in 1861, that was over 12 feet, the skin, when removed, measured 13 feet 5 inches.

Sir G. Yule, K.C.S.I., has heard once, at least, of a 12-foot tiger fairly measured, but 11 feet odd inches is the largest he has killed, and that twice or thrice.

Col. Ramsay killed a tiger in Kumaon, 12 feet. I have myself seen and killed tigers over 10 feet, and have notes of some: one, for example, killed in Purneah, in 1869, 10 feet 8 inches in length.

Gen. Ramsay mentions the skin of a tiger partly killed by himself near Benares that measured over 12 feet. This had no doubt been stretched, but it was a very large tiger.

Col. J. Sleeman does not remember having killed a tiger measuring more than 10 feet 6 inches in the skin. He saw the skin of one at Dinagepore, over 12 feet in length; this was also no doubt stretched. Col. J. Macdonald has killed a tiger of 10 feet 4 inches. He says: "I do believe tigers have exceptionally reached 12 feet."

The Hon. R. Drummond, C.S., killed a tiger 11 feet 9 inches in length before being skinned.

Col. Shakespeare killed a tiger of 11 feet 8 inches.

In regard to the allusion to Buffon's tiger of 15 feet, and Hyder Ally's of 18 feet, I refer to but to express my distrust of them.

It is needless to adduce further evidence. I repeat that though male tigers over 10 feet may be uncommon, they do *occasionally* (and I said no more) attain the greater size.

June 17 J. FAYRER

Zoological Geography

IN the annual address of the President of the Geological Society of London, just issued, an extract is given by anticipation from the forthcoming work of Dr. Günther, on the gigantic land-tortoises, wherein that naturalist discusses the question of the geographical connections by which the tortoises of the Mascarine region may have been related to those which are found in the Galapagos Islands.

As neither in this extract nor in the presidential discussion do I find any allusion to the circumstance that, according to the paper of Dr. Litton Forbes, in the *Journal* of the Geographical Society for 1877, *Didunculus strigirostris*, a near congener of the Mascarine *Dodo*, is living in Upolu, one of the islands of the Navigator group, I venture to call attention to it. Since this island lies in 14° S. lat., and is distant 130° of longitude, in a direct line eastwards from the Mauritius, towards the Galapagos, the presence on it of this ground-bird seems to show that the ancient geographical connection from the Mascarene to the Galapagos Islands was eastwards across the Indian and Pacific Oceans, rather than, as Dr. Günther thinks, westwards by way of Africa, the Atlantic, and South America; for by it more than three-fifths of the 210° of longitude, which in the easterly direction separates the Mascarine region from the Galapagos, and presents a difficulty to Dr. Günther, are bridged over.

The Navigator group, together with a multitude of other islands in the South Pacific, which extend to within 40° longitude of the Galapagos, appear to be small remnants of that continent of very remote geological age of which Australia, New Guinea, and New Zealand constitute larger remnants; and perhaps I may be allowed to observe that the suggestion made by Dr. Günther in reference to the extinction of the gigantic tortoises, viz., that they may be supposed to have once spread over the whole of the large area which connects the places of their present occurrence, but to have been unable to survive the arrival of man or the large carnivora, is precisely that which, many years ago,[1] I offered as the explanation of the extinction of the great wingless, or ground-birds, wherever they were unprotected from these enemies by insulation. This formed part of the argument by which in 1860 I endeavoured to show to the Geological Society that most of the land-tracts of the southern hemisphere were remnants of an ancient continent, which had become insulated at different times during the secondary or mesozoic period.

SEARLES V. WOOD, JUN.

Martlesham, Suffolk, May 27

Time and Longitude

IN NATURE, vol. vii. p. 68, the Rev. J. Pearson asked, "In what part of the globe and in what meridian does October 20 end and October 21 begin?"

The question was answered by several correspondents. Still the following may be interesting as a matter of fact in connection with Mr. Latimer Clark's letter in your issue of May 9.

The date was fixed in many of the Pacific Islands by the early missionaries, who, sailing eastward from Australia, kept the date of the eastern hemisphere after they had crossed the meridian of 180°. This imaginary boundary line cuts through the Fiji Islands, the principal islands of the group being in the eastern hemisphere. It would, of course, be inconvenient to have two dates in one group of islands, especially as the meridian of 180° passes through the north-east point of Vanua Levu, the island of Taviuni, and another small island. Such an arrangement might possibly lead to the necessity (if a stickler for strict accuracy should build his house across the line) of a person going from one day to another by passing from one part of the house to another. It would, to say the least, be awkward to sleep during the night of October 20–21 and on arising on the morning of October 21, by simply walking into the breakfast-room, to cross the boundary-line, and find oneself back into the beginning of October 20.

The Tongan and Samoan Islands are a few degrees east of the meridian of 180°; consequently they ought to be a day behind the neighbouring Fiji group. But hitherto their chief commercial intercourse has been with Australia and New Zealand; and this, for the sake of convenience, has led to the date of the eastern hemisphere being retained up to the present time, although a change has been advocated in Samoa more than once.

In consequence of the present arrangement these little islands have the honour of leading the world in the matter of time, whereas they ought, according to their geographical position, to wind up the rear. There is, however, one drawback to the honour: all our dates, when compared with those of the rest of the world, need to be put back twenty-four hours. This should be remembered in connection with observations of natural phenomena. To obtain local time we add 12 hours 33 minutes to G.M.T. instead of subtracting 11 hours 27 minutes.

S. J. WHITMEE

New Lunar Crater

I was much interested in the account which your last number (vol. xviii. p. 197) contained of the presumably new lunar crater discovered by Dr. Klein in the Mare Vaporum. Is it really necessary to ascribe the formation of such a crater to *present* volcanic action? It seems to me that this singular phenomenon of the birth of a new crater may be more likely owing to such action having, in long-past ages, left (as in all probability it would leave) extensive caverns beneath the visible surface of our satellite. Such caverns might, in consequence of the gradual changes which the action of the sun's rays, alternating with intense cold, must produce on the lunar rocks, occasionally give way. A crater-like cavity would then be caused on the moon's surface by this subsidence, such as are not unfrequently seen in mining districts where old workings have fallen in. The fact that the new crater is elliptical, and not round, seems to add to the probability of its having been caused by some such "settling" process. If the crater were produced by active volcanic agency, it would surely be circular, or nearly so. I do not find this mode of quasi-crater formation suggested in Nasmyth's book, nor, so far as I can remember, in any other. Is it not, however, a possible cause of change on the surface of our satellite?

EDWARD GREENHOW

Cardiff, June 22

Opening of Museums on Sundays

I AM delighted to find from my friend Prof. Dyer's letter tha I was mistaken in the belief that the Maidstone Museum was "the first and only scientific museum that has yet been opened on Sunday in the United Kingdom."

Still the fact that "the Botanical Museum of the Royal Gardens, Kew," is not closed when the Gardens are opened to the public on Sunday, a fact which I had overlooked, although important enough in itself, is not for a moment to be compared with the deliberate opening of the Maidstone Museum by the town authorities.

Had the Botanical Museum not been attached to the Royal Gardens there can be no doubt that it would still be closed on Sunday, as the British and South Kensington Museums are; the opening of one of these institutions would be a parallel case to that of Maidstone.

I am happy to be able to state that a motion for rescinding the resolution under which the Maidstone Museum was opened on Sunday has been defeated in the Town Council.

May I express a hope that there are many towns which will not long remain behind Maidstone in this matter.

10, Bolton Row, W. H. CORFIELD,
Mayfair, W. Chairman of the Committee of the Sunday Society

P.S.—I have just been reminded that the Natural History Museum in Dublin has been open to the public on Sundays for

[1] *Quarterly Journal of the Geological Society* for 1860, p. 329; *Phil. Mag.* for March, April, and May, 1862.

some months past, a fact of which the members of the British Association may take advantage this year. It is now Scotland's turn. W. H. C.

Ophrys muscifera

ON the afternoon of June 2, 1878, I observed some new facts, which, I think, are of importance in elucidating the hitherto mysterious fertilisation of the Fly-Orchis. In sunny weather and under normal conditions the labellum secretes fluid, and a broad central longitudinal stripe of its surface is covered with small drops. Of fifty fresh flowers I found the labellum in thirteen covered with drops, in twenty-five shining with adhering moisture, in twelve without any conspicuous trace of fluid. The two small shining projections on each side of the base of the labellum (the sham-nectaries of Sprengel) were quite dry in all the flowers. In one flower I saw a fly (Sarcophaga sp.) sitting on the labellum and licking the drops. Its head was directed towards the base of the labellum. On my approaching it flew away before having reached the sham-nectaries, and the flower visited by it was found without pollen on the stigmas, and with both pollinia in their cells. Nevertheless, it is most probable that this fly, if not disturbed by my approach, would have stepped forward on the labellum, and, trying one of the sham-nectaries, would have removed one of the pollinia and perhaps transferred to the stigma of another stem, in the manner described by Charles Darwin ("Fertilisation of Orchids," p. 47).

For observing the fluid secreted by the labellum it may be essential to examine plants in their native habitats, not plucked ones. HERMANN MÜLLER

Lippstadt

The Jura

IN the midst of the enjoyment of quiet and beautiful scenery I cannot refrain from writing, in the interest of geology, to attract attention to the facilities for the study of the Jura range afforded by a railway recently opened from Bâle, *viâ* Délémont and the Münster Thal, to Bienne. It crosses the range at, relatively to the anticlinal, a considerable angle, necessitating no less, as I am told, than twenty-five tunnels great and small (I did not count them myself).

Consequently, in a short morning's railway ride the traveller sees a vast deal of Jurassic structure, added to which the Münster Thal, formerly a rather tiring day and a half's drive, is replete with rock, forest, and pasture scenery of very great beauty.

Travellers thus crossing the Jura on their way to the Alps and returning from Lausanne by Vallorbes to Paris, will thank me, I think, for pointing out what, if only from a scientific point of view, are two recently-developed routes, far more interesting than the customary approaches to this land of wonders. I repress poetic and mountaineering sympathies.

Pension Mounoud, Veytaux-Chillon, Canton Vaud, June 21 MARSHALL HALL

THE TRANSIT OF VENUS PHOTOGRAPHS[1]

THE photographs which have been measured were taken with the five photoheliographs made by Mr. Dallmeyer for the Transit of Venus expeditions, on "patent plates" 6 inches square, the images of the sun being very nearly 3·9 inches in diameter. The dry process of Capt. Abney was used throughout.

The measuring instrument, the determination of the errors of its glass millimeter scale, and the method of obtaining the optical distortion of the photoheliographs, have already been described in the Society's *Proceedings*. It has been found by an elaborate investigation that the lines of equal distortion were sensibly circles concentric with the centre of the field. The actual correction for distortion for that zone of the field in the points to be measured generally fell, was exhibited on the board, and was almost identical for all five instruments.

Before commencing the measures of a negative, the position of the line of centres was marked upon the film by a simple mechanical process. This operation has been performed independently by Mr. Burton and myself, with no sensible difference. I have paid no attention to the marks left by Mr. Burton on the plates, and found that my own coincided with them in direction.

In placing the negative in the instrument the circular carrier was turned about until the line of centres was truly parallel to the direction of the sliding motion of the microscopes.

When the negatives are placed under the microscope with an amplification of only five or six diameters, the limbs of both planet and sun, even those which are pretty sharp to the unaided eye, become extremely indistinct, and the act of bisecting a limb with the wire or cross of the micrometer is mere guess-work. The deposit of silver fades off gradually to nothing, and the denser the film the broader generally is the zone of fading off and the more uncertain the measures. In many cases the difficulty is aggravated by ruggedness due to atmospheric disturbances, but the smooth and gradual fading off is the chief cause of uncertainty.

There is only *one* really sharp picture in the whole collection, including the Indian and Australian contingents, and that is one of Capt. Waterhouse's wet plates, taken at Roorkee with a Dallmeyer instrument precisely similar to the others.

It should be remarked that in these instruments the artist has attempted to unite the photographic and visual foci on the collodion film. No doubt some sharpness of the photographic image was thus sacrificed, but this has little or nothing to do with the unfortunate failure of the photography generally.

Each photograph has been measured six times by Mr. Burton and six times by myself. I am not able to include in my series of measures all the photographs measured by Mr. Burton, for the reason that when some of them were viewed through the microscope I could see nothing to bisect, either from the extreme faintness of the film, or from its too gradual fading off.

Mr. Burton generally employed a cross of webs, but I have preferred a single very fine web, the breadth of which was eliminated in the mean by the mode of bisecting.

It had been suggested that the measuring instrument should possess the power of rotating the sun's image about a mechanical centre. This would be useful in some cases of rugged limbs when the sun's image was not rendered elliptical by refraction, but in my opinion would make no material difference in the accuracy of measurement. The rotation could only be applied to the limbs of the sun, whereas, perhaps, the greatest difficulty had been at the limbs of the planet.

From the measures, corrected for distortion, were obtained the photographic diameters of the sun and of *Venus*; the former presumably enlarged, the latter diminished by irradiation in a sensibly equal degree. The sum of the measured diameters in millimetres was compared with the sum of the tabular diameters, subject to errors, for the scale value, and thus every photograph furnished its own scale.

The measured distance of centres affected by errors of semi-diameter was then compared with the tabular distance affected by errors of parallax, right ascension, and north polar distance. From each photograph was formed an equation involving all the unknown quantities, of which the errors of parallax and of semi-diameters were the more important.

The rigorous solution of the equations resulting from Mr. Burton's measures is,

$$\begin{aligned}\text{Mean solar parallax} &= 8''{\cdot}165 - {\cdot}209\,(dR + dr)\\ ,,\ d\,\text{R.A.}\ \ldots &= +\,5{\cdot}38 + {\cdot}287\,(dR + dr)\\ ,,\ d\,\text{N.P.D.}\ \ldots &= -\,5{\cdot}10 - {\cdot}882\,(dR - dr).\end{aligned}$$

The parallax deduced being absurdly small—altogether inadmissible, indeed—the Astronomer-Royal suggested that the quantity $(dR+dr)$, or the sum of the corrections to the tabular semi-diameters, should be considered the

[1] Paper read by Capt. Tupman at the meeting of the R.A.S. on June 14, on the measurements of the Transit of Venus photographs.

only unknown, and that approximate values of the true solar parallax and of the errors of R.A. and N.P.D. should be substituted in the equations. This was done, the mean solar parallax being taken at 8″·85, *d* R.A. as + 5″·81, *d*N.P.D. as − 5″·33, which values resulted from the general solution of the whole of the contact observations, and the following values of $dR + dr$ were obtained:—

Station.	By Burton's Measures.	Number of Photographs Measured.	By Tupman's Measures.	Number of Photographs Measured.
Luxor	− 0″·96	11	− 0″·13	12
,,	− 1·18	11	− 1·61	11
,,	− 2·21	11	—	—
Honolulu	− 1·29	11	− 0·21	12
,,	− 1·75	11	− 0·54	12
,,	− 0·71	10	—	—
Rodriguez	+ 1·19	11	+ 2·44	9
,,	+ 0·23	10	+ 2·49	6
,,	+ 2·10	10	+ 2·74	8
,,	+ 0·14	11	+ 1·27	10
,,	+ 1·46	11	+ 2·31	9
Burnham, N.Z....	+ 0·68	13	{ + 1·89	3
			{ + 1·38	10
Kerguelen	+ 1·51	8	—	0

The above is perhaps the best way to exhibit the nature of the discordances. They might also have been shown as apparent errors of the tabular distance of centres.

The discordances of any one station are too large to admit of the measures being employed with advantage for the determination of the solar parallax. They are due to inherent defects of the photographic images. The reason why at the two northern stations the signs are all *minus*, while at the three southern they are all *plus*, is at present obscure, and I am not prepared to offer any suggestion as to the cause.

THE NORWEGIAN NORTH ATLANTIC EXPEDITION

I SEND you inclosed a clip from the *Dagbladet*, containing the route of our expedition for the coming summer. I hope to be able to send you notes from our expedition during our several stays in Hammerfest. H. MOHN

"According to the plan of this expedition, the *Voeringen* was to start from Bergen on its third and last cruise on the 15th inst. It will probably have reached Tromsoe by the 19th inst., and, after taking on board a pilot acquainted with the northern waters, have immediately proceeded to Alten Fiord, mainly to inspect the meteorological station there, and to examine the animal and plant-life of the Fiord bottom. The magnetic observations required for regulating the compasses, &c., were to be made at Hammerfest between the 21st and 24th inst. The course was then to be set eastwards, in order to examine the relations of depth and animal life, &c., in two of the fiords of Finmark. After touching at Vardoe on the 27th, the voyage is to be continued to a point midway between Vardoe and Novaya Zemlya, in order to take soundings and determine the boundary of the ice-cold water in the East Polar Sea, which hitherto in these regions has only been observed at Bear Island by the well-known Austrian Polar explorer Weyprecht, in his excursion thither several years ago in the Tromsoe yacht *Samson*. This thorough examination of the sea off the north-east coast of Norway, towards Novaya Zemlya will be of special importance for the study of the migrations of the "lodde" (*Malotus arcticus*), as it is probable that it is there that this salmon-like fish has its abode whence in spring it makes its way in large shoals to the coast of Finmark to spawn, pursued by the cod, which follows it and is accordingly taken; while the so-called "lodde" fish, as is well known, is not fished for, because it is not suitable for human food, on account of its penetrating unpleasant odour.

This eastward cruise of the *Voeringen* will scarcely occupy more than ten days, as the sea is here so shallow that taking soundings, &c., need not occupy much time, and the *Voeringen* may accordingly be expected back at Hammerfest on July 7, to take on board coal, water, &c., for a new cruise to the westward in the navigable waters north of Jan Mayen, which the expedition visited last year; thence to the Greenland ice, where the seal fishing is usually carried on, in order to ascertain the boundary between the Greenland Polar current and the Gulf Stream. The stretch of sea that will be traversed by the *Voeringen* has not hitherto been surveyed, and here will doubtless be found, by means of the lead, the beginning of the great Polar sea-depth which runs in between Greenland and Spitzbergen. The *Voeringen* will then return to Hammerfest to make preparations for the third cruise.

This cruise, which will be the last, will be commenced on July 29, and be occupied with the survey of the navigable waters between Bear Island and Spitzbergen, where the well-known shark fishing is prosecuted, and the great sea-deeps off the west coast of Spitzbergen (76° to 80° N. lat.) which hitherto have only been surveyed, and that incompletely, by two of the Swedish expeditions. The *Voeringen* will go as far north as it can for ice, but there is certainly no great expectation that the Norwegian expedition will be successful in carrying off the prize in the competition with other nations to reach the North Pole, for the *Voeringen* will certainly soon meet with ice in the navigable waters on the north coast of Spitzbergen, and it is not fitted out for a North Pole expedition. Leaving it to the enterprising publisher of the *New York Herald* and others to endeavour to reach this goal, the *Voeringen* will, instead, after having turned southwards, survey the fiords and banks on the west coast of Spitzbergen. There the Norwegian fishermen, as is well known, carry on a not inconsiderable cod-fishing, the yearly catch numbering 300,000 to 400,000 fish. But if we keep in view the recent discovery of the great fishing bank off the Lofoten Islands, it will be seen that the fishermen need not undertake the long and troublesome voyage to Spitzbergen to catch cod. They will find superabundence of larger and better fish at the banks off Vesteraalen, so to speak, lying before their own door. But these Lofoten fishing banks are for the time being visited by the Norwegian fishermen as little as the bank abounding in fish which lies off the Froey Islands (north-west of the mouth of Trondhjem Fiord), although the latter was known to old fishermen. The surveying-steamer *Hansteen* has now mapped it. It is besides beyond all doubt that one of the practical results of the Norwegian North Atlantic Expeditions will be a better turning to account of the rich fishing banks of whose position, animal and plant life, more precise information has now been obtained.

The return from Spitzbergen will take place at the end of August, and the *Voeringen*, after having touched at Hammerfest or Tromsoe, and Bergen, where the members of the expedition resident there will land will probably resume its course in the middle of September, terminate its voyage in the harbour of Horten."

The members of the expedition are the same this year as last, viz., Profs. Dr. H. Mohn, meteorologist; Dr. G. D. Sars, Dr. Danielssen, and Herr H. Friele, zoologists; candidate Tornœe, chemist; assistant-candidate Schmelck, physicist and chemist; and the landscape-painter Herr Schiertz, as artist. The *Voeringen* will be commanded this year, as formerly, by Capt. Wille of the Royal (Norwegian) Navy, the second in command being the sailing-master, Capt. Greig. The expedition carries with it several valuable new instruments for measuring more exactly the temperature of the water at great depths; some of them have, with great good will, been obtained from the members of the English *Challenger* expedition. As in the preceding years, Prof. H. Mohn will send to NATURE communications from the expedition.

PHYSICAL SCIENCE FOR ARTISTS[1]

VI.

THE diagrams given in my last article should have made it quite clear that the various sunset and sunrise colours are due to the absorption produced by different thicknesses of aqueous vapour; that the colours of clouds are due to light falling upon them after absorption by different thicknesses of aqueous vapour; and finally that the blue colour of the sky in the zenith is due to the fact that the pure gases in our atmosphere exist in that molecular grouping which vibrates in harmony with the short waves of light.

The blue sky, however, is scarcely ever a true blue. Between us and it there is ever a misty veil which reflects to us the white light of the sun, as an examination of it by a pocket spectroscope will prove to anybody. It is to the variation in the quantity of this misty veil that the difference in the colour in the sky at great and low elevations, in different climates, and in the same climate, when clouds are about to form and when scarcely the germs of clouds are present, is to be ascribed. The thickness of our atmosphere is so moderate that neither the hypothetical red nor the blue molecules of aqueous vapour are competent, except during thunderstorms, to influence its colour as they undoubtedly do near the horizon.

A glance at Fig. 4 in the last article will explain how it is that sometimes in the case of clouds we find the before-stated order of sunset colours reversed. If, for instance, we imagine a cloud lying along the curve $x s'$, an observer at o will see a cloud at x higher above the horizon than one at s', but the cloud at x will have received light through a greater thickness of atmosphere than the cloud at s'. The red, therefore, at x will be more *foncé* than at s'; the order of colour, though not of brilliancy, will be reversed.

So far we have considered these colours looking towards the rising or setting sun. Let us now turn our back on that luminary. It will be at once obvious that if, for instance, we take a point on the horizon, there will be an enormous increase in the thickness of atmosphere traversed by the ray; indeed, we may say that for this point the absorption will be threefold. Hence a considerable reduction of light, a ruddier tinge, due to the increased absorption of the more complex molecules, and a mingling of the ruddier light with the blue sky.

In the voyage which I made to India in 1871 I scarcely ever missed a sunrise or a sunset, and although the point of sunrise or sunset was almost always the scene of a succession of glories unsurpassed in beauty, the point opposite was, if possible, more interesting, the colours were more subdued, and of a more composite order, but the work of law went on there, as elsewhere. If any clouds happened to be overhead, their greatest glory, which, as I have already shown, can only be put on when the sun is below the horizon—and the sun rises or sinks much more rapidly there than with us—was the herald of the shadow of the earth on the illuminated sky, which crept on a gigantic, mysterious crescent. That the shadow of the earth could thus be seen was new to me, and I am the more glad, therefore, seeing that many may doubt it still, to substantiate my observation and its explanation by a quotation from Prof. Brücke, one of the most distinguished members of the Vienna University. Prof. Brücke has been doing on the Continent what I have been attempting to do in these articles, and just before my last one appeared I saw in *La Revue Scientifique* an extract from his forthcoming work "Principes Scientifiques des Beaux Arts." I am delighted to see how much at one we are, but for the moment I shall content myself by giving what he says on the point to which I have referred. Talking of sunset he writes:—

"We see on the horizon to the east a grey blue stratum rising higher and higher, and stopping at that portion of the sky coloured red: it is the shadow of the earth.

"The shadow of the earth must always encounter an unilluminated part of the atmosphere. As this shadow does not fall on a surface, but on a great number of particles spread abroad in space, it is material, that is to say, it has three dimensions, and we see it, foreshortened—in perspective.

"Sometimes the regions above it are divided in a radial direction into sectors, some of which are dark, like the shadow of the earth, others red. These resemble in the sky the rays of the aurora borealis, and often change their place and size; in French they are termed 'les rayons de crépuscule.' They are due to the fact that in the path of the solar rays there are masses of clouds which only give passage to isolated ones here and there, which make their presence felt by the luminous train which they leave among the particles of the atmosphere. Hence arise those red prismatic masses spread abroad in the air east and west. At the zenith we do not remark them, because the vision cuts across them, and the stratum of illuminated particles is not thick enough to render them sensible; but we see them painted on the eastern sky because we regard them obliquely in the sense of their length; we see them in perspective. By their nature and their mode of origin they do not differ from the beams which the setting sun throws between the intervals in the clouds, nor from those which it sometimes casts in the morning or afternoon through the clouds, when the peasants say that 'the sun is drawing water.' 'Voilà un bouillon qui chauffe.'"

This paragraph not only supports my view, but it opens up several very interesting points on which, if space permitted, there would be much to say; one or two words, however, must suffice.

The rifts to which Prof. Brücke has drawn attention do not always arise from clouds; in fact, they are not seen in their greatest vividness when they do. One evening I saw them thrown, in a perfectly cloudless sky (in fact, there had been no cloud all day), by the sky-line of Socotra, which island we had passed during the day, and which was below the horizon at the time. Capt. Parish, in command of the *Mirzapore*, to whom I appealed at the time, took the bearing of these rifts, which, in their sharpness and magnitude, were almost appalling, and put the question beyond all doubt.

With regard to the "sun drawing water," artists should note the absence of all colour and the radial direction of the beams, all meeting in the sun's place. For some reason or other many artists are not yet quite clear about this appearance, and compromise matters by making the beams look like a distant rain-shower. There are some notable examples of this in the South

[1] Continued from p. 157.

Kensington Museum. That phenomena so diverse in their origin and appearance should be mistaken for each other does not say too much in favour of the cultivation of the observational faculties of artists as a rule.

I shall next refer to two or three other questions which have been dealt with by Prof. Brücke in the article to which I have referred. Prof. Brücke is again with me to a certain extent in tracing the origin of most sky-colour to a defect of the blue light, but he does not make the attempt to run it to earth that I have done, by ascribing it to aqueous vapour; indeed he considers it rather due, I take it, to the presence of solid particles in the air. Thus, after pointing out that the dawn is generally orange, and the sunset redder, he states that at night the quantity of molecules capable of troubling the air is generally greater. For my own part, I should be inclined to ask whether, during the night, the molecules of aqueous vapour which absorb the blue have not been driven into higher forms—*dew* being one of them—owing to the reduction of temperature. This would at once explain not only the generic difference between sunrise and sunset colours, which is more marked here than in the tropics, but also the golden instead of red sunsets which accompany the formation of cloud.

Another point of difference. Prof. Brücke considers green sky as an effect of contrast produced by the quantity of red light which enters the eye. I cannot agree to this, first, because I have given a physical reason for the green; and secondly, because I have observed it without any strong contrast of colour to mislead the eye. The considerable darkening of the green after sunset is, I believe, purely physiological; and it is an effect of so curious a nature, that it raises several interesting questions with regard to the manner in which the eye grapples with the middle colours of the spectrum, namely, the orange, yellow, and green, which can be made to change to a certain extent according as the light is more or less intense, which does not happen with the other colours.

The changes in mountain scenery form the subject of several interesting remarks by Prof. Brücke. As long as distant mountains are illuminated by a high sun, their outlines are not very clear; because, as he well puts it, the reflection of this light from the lower strata of the atmosphere is then so great that the illumination at the horizon, where mountains are, is as strong as where they are not. He then points out that at night the setting sun fills the sky towards the west with a great brightness which renders the profiles of the mountains between us and the sun much darker. Their contours are neatly detached, but it is not only on the horizon that this is seen; the various chains are better distinguished, and appear one behind the other like the scenes in a theatre, because the light in which we see them does not come from them but from the interposed air. The sides of the mountains which we see are dark because the other sides are turned towards the sun, but the various thicknesses of air interposed between us and them reflect to us the sunlight; hence the atmosphere of a picture is truly the work of the air.

Here is what Prof. Brücke says about sunset tints; I do not follow him in all his explanations:—"When the sun reaches the horizon and the red tint is developed, the colours of the landscape change in their turn and the mountains themselves appear red when we regard no longer their shadows but the illuminated air which lies in front of them." It appears to me this gives too much work to the air; a rock surface is generally as capable of dispersing red light which falls upon it, as a molecule of aqueous vapour is; "still the tint has not the intensity of the alpine colour; it is a red less intense and more empurpled, which sometimes approaches even the violet or the lilac."

I shall have a word to say on this, but I will first give Prof. Brücke's explanation:—

"Two causes are at work in this latter case; the first is the mixture of red and blue light. At night when the sky is clear the shadows are coloured a strong blue. The shadow region is illuminated by the blue light of the sky, and appears more pronounced, owing to the contrast of the reddish-yellow light, as we have already seen. The illuminated air reflects the blue rays more abundantly than the red ones, and consequently the former have the ascendency. If not scientifically correct, it is at least practically so, to suppose the blue light in which we see the mountains bathed after sunset to be mixed with purple or lilac. The second cause of the violet tone in the distances to the west is to be found in the frequent contrast. In the west, in fact, a great part of the sky is illuminated by yellow light; often this yellow is a perfect sulphur-colour, which contrast makes objects even in the middle distance, which turn their dark sides to us, appear violet; thus, looking to the west, dark, unploughed earth appears violet when the majority of terrestrial objects turn their dark sides towards us."

An observation I made at Cannes last year leads me to think that the whole cause of this purple colour has not been stated in the foregoing. It was near the hour of sunset, and I was looking towards the south-west, delighting in the blue colour at the foot of Les Estrelles—while their crests were being gilded by the sunset—when, almost instantaneously, the valley to the north of these hills was enfiladed by a beam from the sun itself, which threw part of the aqueous vapour in the valley into a frenzy of gold. This gradually got ruddier as the sun got lower, and the amount of vapour lighted up between me and the blue vapour at the foot of the hills was at the same time reduced; the blue and the red then melted together into the richest and most beautiful purple that I, at all events, have ever seen.

We have only, then, to assume that, when we thus see purple, that colour is produced by a mixture of particles, some of which are reflecting to us the blue light of the sky, because they can do no other, while others, again, are reflecting to us the red light of sunset, because it is more powerful than the light from the sky.

J. NORMAN LOCKYER

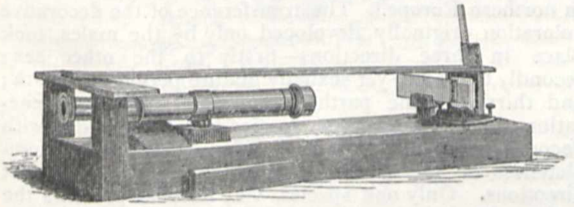
AN ECLIPSE SPECTROSCOPE

SOME little time ago I communicated to the Royal Society a suggestion for the use of Mr. Rutherfurd's reflection gratings in obtaining photographs of the coming eclipse. The plan suggested was that the grating should be placed short of the focal point of a telescope, and at right angles to its axis, and that the diffracted images of the chromosphere should be received on photographic plates adjusted for the different orders of spectra on either side the axis. I am glad to learn from Prof. Newcomb that the value of this method of observation will probably be tested by Prof. Young, who is in charge of one of the six expeditions already organised to observe the eclipse. The chief defect in this mode of observation lies in the difficulty of determining the position of the lines photographed, supposing the chromospheric spectrum to vary considerably from the ordinary solar one so far as the intensity of the lines is concerned; and as it seemed desirable that these gratings should be utilised for less serious attacks, I have recently been endeavouring to see if the method can be improved.

The annexed woodcut shows one form of the new arrangement, which has many conveniences. It is a rough model on wood, but will suffice to show the method of use.

The grating, which is free to rotate, is placed in front of a little telescope of low magnifying power and the stand which carries both is so placed and the grating so adjusted that the image of the light source is seen in the little telescope reflected by the general surface of the metal grating. Supposing a circle and micrometer attached, represented by the wooden bar at the top, the reading would now be zero.

Next, and this is the new point, a piece of glass silvered on the front surface is fixed with its surface parallel to the surface of the grating, the side of which it covers. When this is in perfect adjustment the images produced by the movable grating and the fixed mirror are superposed. Let us suppose the light source to be a Geissler tube, we get a single image of it; the fixed mirror is then very slightly inclined, so that its image lies a little above or below the one due to the grating. We now by the movable arm at top rotate the grating, the grating image vanishes from the field of view, and in a little time, if the rotation is continued, the blue of the first order spectrum makes its appearance. Each coloured image in the spectrum can in turn be brought to coincidence, with the non-dispersed image of the tube thrown by the fixed mirror, and readings of considerable accuracy can thus be obtained. The illumination of the image due to the



fixed mirror can be easily regulated by changing its position with regard to the axis of the telescope prolonged; in no case of course should any part of the ruled surface of the grating be covered. With a ring slit illuminated by the vapours of different metals, the phenomena observed are very interesting and novel; with the fixed mirror slightly inclined, the image from the fixed mirror always in the centre of the field of view forms a capital point of comparison.

More light is gained by employing an object-glass of short focus and placing the grating and fixed mirror at such a distance inside the focus that the beam falls on the ruled surface and a small fraction of the fixed mirror.

I hope the suggestion does not come too late to enable it to be utilised by the outposts during the coming eclipse. If it helps in enabling us to determine the position of the chromospheric line near H, the time I have spent on the little model will not have been thrown away. I may add that I have found that a prism of 60° dense flint placed in front of the lens of an ordinary photographic camera will give us, if properly focussed, a most useful spectrum of the eclipsed sun. J. NORMAN LOCKYER

OUR ASTRONOMICAL COLUMN

NEAREST APPROXIMATIONS OF SMALL PLANETS TO THE EARTH'S ORBIT.—Out of the 187 minor planets now known there are ten which approach the earth's orbit at their perihelia within 0·9 of her mean distance from the sun, and which may therefore afford the most advantageous opportunities for determination of the solar parallax by one or other method of observation of these bodies, already successfully applied: *Medusa* is omitted on account of uncertainty of elements. The nearest approach, 0·798, is made by *Clio*, discovered by Luther in August, 1865. *Æthra*, detected by Watson in June, 1873, makes the nearest approach to the sun 1·614; but the great depression of the planet below the plane of the ecliptic, at perihelion, prevents so near an approximation to the earth's orbit as in the case of *Clio*. The following is a tabular view of the distances in the ten cases referred to:—

	Perihelion Distance.	Heliocentric Latitude in Perihelion.	Distance from Earth's Orbit.
84. Clio	1·805 ...	+ 1° 57 ...	0·798
132. Æthra	1·614 ...	− 23 45 ...	0·813
18. Melpomene... ...	1·796 ...	− 7 9 ...	0·815
43. Ariadne	1·834 ...	+ 0 48 ...	0·818
12. Victoria	1·823 ...	+ 7 40 ...	0·828
80. Sappho	1·835 ...	+ 5 53 ...	0·842
8. Flora	1·856 ...	− 5 45 ...	0·874
33. Polyhymnia ...	1·890 ...	− 0 53 ...	0·882
42. Isis	1·890 ...	− 6 53 ...	0·892
50. Virginia	1·896 ...	− 0 47 ...	0·896

If we extended our limit to 1·0 we should include, in addition to the above, *Felicitas*, *Phocea*, *Euterpe*, *Thyra*, *Echo*, and *Feronia*.

While referring to the small planets it may be remarked that, between the perihelion of *Æthra* and the aphelion of *Hilda*, there is a difference of 2·98; and between the aphelion of *Flora* and the perihelion of *Hilda* 0·76, or upwards of three-fourths of the radius of the earth's orbit. The periods of *Flora* and *Hilda* being respectively 3·27 and 7·85 years exhibit a difference of 4·58 years. These are the extremes, as they result from the latest and most complete catalogue of elements.

According to the last Circular of the *Berliner Jahrbuch*, the following names have been proposed:—For No. 177, *Irma*, for 180, *Garumna*, and for 186, *Celuta*.

MEASURES OF DOUBLE STARS.—Many applications for copies of the earlier volumes of "the Leyton Observations" having been received after the edition had been exhausted, Mr. J. Gurney Barclay has issued a fourth volume containing the double star epochs from the commencement of observations at Leyton, with the addition of results to the end of 1877. This part includes also occultations and phenomena of Jupiter's satellites since 1865. The notes on the double-star observations comprise the principal epochs of other observers. The small companion of Procyon at a distance of about forty-five seconds, to which attention was first pointedly directed by Mr. Barclay in January, 1856, had the following position for 1863·23, angle, 294°·88, distance 45″·9, which, corrected for the proper motion of Procyon in the interval, gives for 1879·0 angle, 319°·3, distance 47″·3.

The *Astronomische Nachrichten*, Nos. 2196-99, contain measures of double-stars made by Dr. Doberck at the observatory of Col. Cooper, Markree Castle, Sligo, from the end of 1875 to the spring of 1878. The list includes most of the well-known binary systems. γ Coronæ was single in the Markree instrument in 1876-77.

Mr. Ormond Stone, Director of the Observatory at Cincinnati, writes with respect to a remark in a notice of the Cincinnati measures of double-stars, which appeared in this column, and which might be misunderstood as implying that the work carried on at the American Observatory is to a certain extent a duplication of that commenced some time since with the refractor at Melbourne. Mr. Ellery, however, has lately informed Mr. Ormond Stone that his observations are limited to stars south of 35°.

THE BINARY STAR α CENTAURI.—Mr. Maxwell Hall writes from Jamaica, on May 21, with reference to α Centauri: "Since my communication last year respecting this binary, the angle of position of the smaller star has rapidly increased at the rate of 60° per annum. I have lately taken measures in the same manner as before, few in number, but with the greatest care, so that their concordance gives them great weight."

Epoch 1878·38 Position 139°·1 Distance 2″·4

Mr. Hall adds: "There can be no doubt that the smaller star is variable: according to my estimates it has diminished during the last year; and I would therefore call attention to the subject"—and appends various estimates from 1½ (Powell, Jacob) to 4 (Dunlop), also a table of the measured angles and distances to 1878, which it is unnecessary to give here, as they will be accessible to most readers who interest themselves on the subject of binary stars. For the interval 1864-76, in which Mr. Hall states he had not measures in his possession, the following may be cited :—

Powell	1870·10	Position	20°·45	Distance	10″·24
Russell	1870·75	,,	22·3	,,	10·46
—	1872·47	,,	25·5	,,	9·74
Ellery	1874·15	,,	30·5	,,	8·00
Russell	1874·47	,,	30·0	,,	7·97

On the question of the brightness of the components Sir John Herschel says :—"Individually their magnitudes have been very differently estimated by other observers from what I consider to be their correct values. All agree in assigning the first magnitude to the principal star, or that which follows in R.A. (1834-37); but whereas Lacaille, and after him Fallows, Johnson, Taylor, and Messrs. Dunlop and Rumker estimate the preceding star of the fourth magnitude, I have never estimated its magnitude as seen with the equatorial lower than 2·3, and the mean of all the magnitudes assigned to it with this instrument is 1·73, or $1\frac{3}{4}$ by a mean of eleven observations. . . . . On the whole evidence afforded by my experience I am disposed to assign to it a magnitude which may be deemed indifferently either a very low first or a very high second." Sir John Herschel further considered that "it is not necessary to recur to the hypothesis of variability to account for this difference of estimation," and gave his reasons for this opinion ("Cape Observations," p. 300).

BIOLOGICAL NOTES

DECORATIVE COLOURING IN FRESHWATER FLEAS.—There is something essentially comic in the notion of a freshwater flea—a species of the entomostracous crustaceous Daphnoidæ—becoming beautifully ornamented with patches of scarlet and blue, for the purpose of seducing the affections of the opposite sex. If a scarlet coat is appreciated by the females of the very fleas of this great family to which we all belong, we ought not to be surprised at hereditary predispositions in favour of this colour, and should conclude on this ground, as on many others, that the civilian male Anthropini of western Europe have taken a foolish and unnatural step, within the last hundred years, in abandoning the use of brilliantly-coloured clothing, and giving over the exceptional advantages which it confers to soldiers and huntsmen. The figures given by Prof. August Weismann, in the *Zeitschr. wiss. Zoologie* (1878, Supplement 1), show us the water-fleas, Polyphemus and Latona, most gorgeously got up in blue and scarlet. Goethe, though he never saw them, foretold their appearance :—

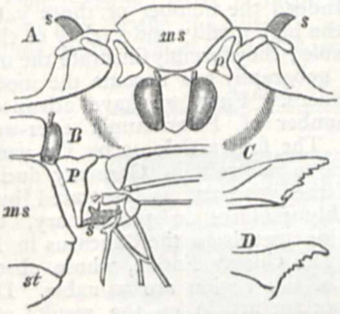
"Es war enimal ein König, der hatt' einen grossen Floh,
Den liebt' er gar nicht wenig, als wie seinen eignen Sohn,

* * * * * *

In Sammet und in Seide, war er nun angethan,
Hatte Bänder auf den Kleide, hatt' auch ein Kreuz daran,"
&c., &c.

It is to the elaborate and ingenious studies of Prof. Weismann on caterpillars—worthy to be placed by the side of the most original of Mr. Darwin's own investigations—that we owe our knowledge of an exceedingly important cause of animal coloration, namely, that which is explained by the term "startling" or "terrifying" colouration (Schreckfarben). Just as in various human races the amorous of both sexes paint their faces and adorn their bodies in order to attract one another, so nature paints by sexual selection, and just as we dress ourselves up in wigs and gowns and spectacles, or tattoo our countenances in order to terrify evil-doers so (Prof. Weismann shows) does nature paint masks with staring eyes upon the feeble caterpillar's back in order that he may enjoy the privileges so usually gained by the ass in the lion's skin. Brilliant patches of colour occur only in a few Daphnoidæ (also in a few Phyllopoda), and after a very detailed investigation as to the variations which these patches of colour present in the different species, in the two sexes, and at different seasons and at different periods of growth, Prof. Weismann comes to the conclusion that they must be regarded as a decoration acquired by sexual selection which probably was first of all confined to the male sex, but subsequently, in most cases, became transmitted also to the other sex. Probably a reciprocal and alternating sexual selection favoured this transference to the female sex, the most brilliant females being chosen by the few males existing at the commencement of a sexual period, and the most brilliant males being chosen by the relatively few females existing at the end of such a period. The existence of these "sexual periods" is a well established feature in the life-history of Entomostraca, alternating with parthenogenetic periods. From the fact that neighbouring colonies of the same species have a constantly differing arrangement of colour, it appears probable that the development of these decorative colour-patches took place after the isolation of the colonies, that is to say subsequently to the glacial period in northern Europe. The transference of the decorative coloration originally developed only by the males, took place in three directions—firstly to the other sex; secondly to the not-yet sexually mature period of growth; and thirdly to the parthenogenetically produced generations. In the various species of Daphnoidæ with decorative coloration we find different degrees of completeness of the transference in these three different directions. Only one species, viz., Latona, presents the highest degree or complete transference of the coloration to both sexes, all stages of growth and all generations of the annual cycle. Prof. Weismann concludes that the Daphnoidæ afford a further case in favour of the hypothesis that secondary sexual characters can be converted into general characteristics of the species, and that they confirm Mr. Darwin's theory of the origin of the colour-patterns of butterflies' wings.

HOW LEPIDOPTERA ESCAPE FROM THEIR COCOONS.—The mode in which butterflies and moths free themselves from their chrysalides has been a subject of some controversy, but of very little recent observation. With regard to the silkworm moth, Malpighi asserted that the animal first wets the silk with a liquid calculated to dissolve the gum that connects the threads, and then employs its lengthened head to push them aside and make an opening. Réaumur, however, maintained that the threads of silk are not merely pushed aside, but are actually severed, and believed that the eyes, which are the only hard organs of the head, are the instruments by which the threads are divided, their numerous minute facets serving the purpose of a fine file. That the threads are actually cut is the general view; and the account of the breeding of silkworms, published in the *American Philosophical Transactions*, states that cocoons, out of which the moth has escaped, cannot be wound. On the other hand it is known to be a common practice with many moths the chrysalis of which is very hard, to discharge, immediately before issuing forth, a copious fluid from the mouth by which the shell is so softened that they are able to force their way through it. In an article in the *American Naturalist* for June, Dr. A. S. Packard, after reviewing our previous knowledge of the subject, gives an account of some interesting observations of his own. His attention being arrested by a rustling, cutting, and tearing sound, issuing from a cocoon of the large green swallow-tail silkworm moth, *Actias luna*, he discovered, on examination, a sharp black point moving to and fro, and then another, until both points had cut a rough irregular slit, through which the shoulders of the moth could be seen vigorously moving from side to side. The hole or slit was made in one or two minutes, and the moth worked its way at once out of the slit. The wings at this time being very small and flabby, and the shoulders being alternately much raised, the points stuck up far enough to cut or saw through the cocoon. The wings were at first of a deep buff yellow, but in half an hour after they began to expand and to turn green. The black points can be detected when the wings are fully expanded, not being entirely covered by the hairs at the base of the wing. In this case no fluid was seen to exude from the mouth, and the cocoon was perfectly dry. The black points are seen, when magnified, to have the form of a rude saw, and Dr. Packard proposes for them the term *sectores coconis*. The cocoon-cutters were found in every other species of the sub-family *Attaci* that was examined; in *Telea polyphemus* they are large and well-developed; they are rather small in *Callosamia promethea*, *Platysamia cecropia*, *P. Gloverii*, *Samia cynthia*, an *Attacus* from Nicaragua, and *Attacus amazonia*, Pack., from Pebas,



Peru; large and well-marked in the European *Saturnia pavonia-minor* and *Endromis versicolora*. In *Bombyx mori* the spines are not well-marked, and they are quite different from those of the *Attaci*. They are three sharp points, being acute angles of the pieces at the base of the wing. No such spines are present in *Eacles imperialis*.

In the accompanying cut A represents a front view of a specimen of *Actias luna* which came out of the cocoon and died with the wings not expanded; the shoulders are elevated, and the rudimentary wings hanging down; *ms* the scatum, *s* the cocoon-cutter, *p* the patagium. B represents another specimen with fully-developed wings; *ms* the scatum, *st* the scabellum of the meso-thoracic segment, *s* the cocoon-cutter, which is evidently a modification of one of the pieces at the base of the fore-wings; it is surrounded by membrane, allowing free movement. C and D are modifications of the spine or *sector coconis* considerably magnified, showing the five or six irregular teeth on the cutting edge, the spine being sharp, curved, and conical. It will be seen that it acts like a rude saw.

FEAR OF SNAKES IN PRIMATES.—Mr. A. E. Brown has recently made experiments in the Philadelphia Zoological Garden, in pursuance of those of Mr. Darwin. He coiled a *dead* snake in a newspaper, so as to be easily capable of coming loose, and set it on the floor of a cage containing a great variety of monkeys. It was instantly carried off by a leading spirit, but in a few seconds the paper became unfolded and the snake was exposed. The monkey instantly dropped it and went away, but with a constant look behind. The other monkeys, perceiving the snake, approached, step by step, and formed a circle round it six or eight feet in diameter. None approached except one Macaque, who cautiously made some snatches at the paper. At this moment a string which had been attached to the snake's tail was gently pulled; the snake moved, consequently, and the monkeys fled precipitately, with great chattering and screaming. Some time after they gradually returned to their former position, and they continued for some hours showing both intolerable fear and a strange attraction. The same monkeys had no fear of a tortoise or a small dead alligator. The same snake was then shown to mammals of other orders, but none of them showed any especial interest. It is seen that the same dread of snakes is shared by the human species, especially women. Mr. Brown was able to trace, in the actions of a woman who was deaf and dumb, very similar fear, attraction, and repulsion to that shown by the monkeys. Is this a relic of early struggles for existence with an enemy whose bite produced results very different from that of other animals, and exposed mankind to a death lingering and horrible?

THE FERTILISATION OF EGGS OF THE LAMPREY.—We have frequently referred to the great progress of researches into the actual phenomena of fertilisation, especially those of Hertwig. Ernst Calberla, of Freiburg, is another most earnest pursuer of this subject, and he has followed the fertilisation of the lamprey. His views corroborate very strongly those of Hertwig, with some additional particulars. He finds a very distinct external micropyle, with a channel in the yolk leading into the ovinucleus (*Eikern*), which is the residuum of the germinal vesicle. The spermatozoon which is so fortunate as to find the micropyle, enters it and gives rise to the sperm-nucleus (*Spermakern*), which appears twenty-six seconds after the entrance of the spermatozoon into the micropyle. In a minute and a half altogether, the cleavage-nucleus (*Furchungskern*) is seen. After five hours the first cleavage furrow arises, at the spot where the micropyle was situated. In the *Zeitschrift für wissenschaftliche Zoologie*, vol. xxx. part 3, Calberla gives a most interesting account of his procedure and observations, and reviews the work of other investigators, giving a capital bibliography which is of value to those interested in such a rapidly expanding subject.

GEOGRAPHICAL NOTES

ADMIRAL SIR GEORGE BACK, F.R.S., died on Sunday at the age of eighty-one years. He entered the Royal Navy when twelve years old as a midshipman on board the *Arethusa*, and in 1818 joined a vessel under the command of Sir John Franklin, whom he accompanied on his expedition overland from Hudson's Bay to the Coppermine River, having already taken part under Capt. Buchan in his perilous voyage of discovery made to the neighbourhood of Spitzbergen. In the spring of 1825 Lieut. Back again accompanied Sir John Franklin on his second expedition to the Arctic regions for the purpose of co-operating with Capt. Beechy and Capt. Parry in their simultaneous efforts to ascertain from opposite quarters the existence of a north-west passage. Full details of this voyage will be found in Franklin's "Narrative of a Second Expedition to the Shores of the Polar Sea." Back was again appointed in the spring of 1833 to conduct the expedition fitted out for the purpose of seeking and relieving Sir John Ross, who had gone out nearly four years previously in quest of the north-west passage. A full account of the results of that hazardous enterprise, in the course of which he discovered the river which has since borne his name, Capt. Back gave to the world in his "Narrative of the Arctic Land Expedition to the Mouth of the Great Fish River and along the Shores of the Arctic Ocean in 1833-35." In 1836 Capt. Back sailed in command of another expedition to the frigid zone. The details of this expedition, in the course of which he reached Frozen Strait, almost within sight of Repulse Bay, were published by Capt. Back in his "Narrative of the Expedition in Her Majesty's Ship *Terror*, Undertaken with a view to Geographical Discovery, in 1836-37." In 1857 he obtained flag rank, but had not been afloat since that date. In 1837 Back had awarded to him the gold and silver medals of the Geographical Society. He also was honoured by the gold medal of the Geographical Society of Paris, of which he was made a corresponding member. He was knighted in 1839, and elected a Fellow of the Royal Society in 1847.

IN the latter part of January and in February last Mr. G. J. Morrison, of Shanghai, made an interesting journey overland from Hankow to Canton. The distance in a straight line is about 525 miles, and he estimates that an ordinary route would be less than 700 miles, though by the route he took it was 860 miles. On the whole, Mr. Morrison does not appear to have experienced any very grave difficulty with the natives during his journey; the people in the southern part of the province of Hupei were very civil, and not very inquisitive; but as he got into Hunan, the population of which is notoriously turbulent, he remarked a great difference. The main portion of his land journey was through a district which had not been visited by a foreigner "within the memory of the oldest inhabitant," and the natives—as is always the case in out-of-the-way parts of China—were most anxious to see the stranger. Mr. Morrison's great trouble appears to have been with his maps, and this was especially the the case where the provinces of Hunan and Kwangtung meet. "The Chinese maps of this district," he says, "are very incorrect, and some foreign maps are worse. The fact that along the north of Kwangtung there is a range of mountains, but that this range does not form the watershed, has been puzzling to geographers. Ichang, which is on the south side of the pass, is still in Hunan, and is situated on the head waters of an affluent of the North River of Kwangtung. This affluent runs in a narrow gorge through the range above referred to." The country through which Mr. Morrison passed on his journey presented many points of interest. Near Wuchang, on the right bank of the Yang-tsze, the land is low and subject to floods, but a short distance to the south it becomes undulating. A little to the west of Puki, on the borders of the great tea-districts, as elsewhere in Hunan, a large quantity of tea-oil is made; the plants from which the seeds are obtained grow about eight or nine feet high, and are more straggling than the tea-shrub. The Siang River, which flows through Hunan, Mr. Morrison found to be in some places nearly a mile broad; but its usual width, when the water is low, is about one-third of a mile. At certain seasons vessels of considerable size are able to ascend as far as Changsha, the capital of the province of Hunan, which is a large and apparently prosperous place. Siangtan, a great trading-place further on, though only a third-class city, is larger than Changsha, and its population is estimated by the Chinese at one million, which, no doubt, is an exaggeration. In the neighbourhood of the borders of Kwangtung the country is bleak and uninteresting. The road over the Che Ling Pass, which is by no means steep, is crowded with traffic, tea-oil, tobacco, &c., going south, and salt and Canton goods going north. The absence of trees is very noticeable both in Hunan and Kwangtung; in the latter the traveller sees the hills for miles denuded of every tree, but in Hunan some attempts are being made at replanting. The part of Mr. Morrison's journey which interested and astonished him most, was the examination of the coal-fields of Hunan and Kwangtung; but it was with very great difficulty that he obtained permission to visit one mine. He noticed that there, as in all Chinese mines, the great want was a good road, which seriously interferes with the output of coal.

AMID all the disasters from flood and drought which have fallen upon China of late, the *North China Herald* says it is pleasant to learn that the great river which has earned the epithet of "China's Sorrow," has not this year justified its name. The Governor-General of the Yellow River reports that the unprecedented cold of the winter caused the upper waters to freeze, and that for more than a month all traffic was suspended, letters having to be forwarded overland by circuitous routes, a necessity which has not arisen for many years, while the pressure of ice in the upper waters caused a rise of one or two feet lower down.

WE have already referred to the fact that relics of the Franklin Expedition have been heard of as in possession of the Nechelli Eskimo away to the west of Hudson Bay. The schooner *Eothen* has left New York under Capt. T. F. Barry—who was in communication with these Eskimo last year—with a party to search for and bring back the relics—among which are said to be written records. The *Eothen* goes to Repulse Bay, whence a party will sledge west about 600 miles to a point near Cape Englefield, where the relics are said to be. The expedition is expected to be away two years and a half.

WE have before us a number of German geographical journals, the nature of whose contents we can only briefly refer to. Indeed the number of these journals in Germany, and the high quality and variety of their contents, are remarkable; they forcibly illustrate the often-repeated saying that geography has become the meeting-place of all the sciences. First, we have advanced sheets of the July number of Petermann's ever-welcome *Mittheilungen*. The first article is by Dr. van Bebber, on the distribution of rain in Germany during the four quarters of the year, and is illustrated by four maps. A remarkably picturesque preliminary, but lengthy, account of his travels in the Caucasus in 1876, is contributed by Dr. Gustav Radde, whose observations on the botany of the region are valuable. Dr. Wojeikoff has an important article on the results of the recent Siberian Surveying Expedition, and Dr. Brehm contributes his usual admirable monthly summary. From the Berlin Geographical Society we have Nos. 3 and 4 of the *Verhandlungen* and Nos. 74 and 75 of the *Zeitschrift*. In the former the principal paper is an account of Thielmann's recent ascent of Cotopaxi, and a long and learned paper by Baron von Richthofen on Prjwalsky's recent journey to Lob-nor. In the *Zeitschrift* (No. 74) is a paper (with map) on the distribution of rain in Europe, by Dr. Otto Krümmel, and a paper of great interest, also with a map, by Dr. Theobald Fischer, on the changes in level of the Mediterranean Coast; the map shows at a glance what parts of the coast are rising and what parts are sinking. No. 75, *à propos* of the recent jubilee of the Society, has a long and interesting account of the progress of geography during the past fifty years, especially in connection with the work done by the Society. This is followed by a paper, with map, on the ethnography of Epirus, by Dr. Kiepert. In the *Mittheilungen* of the Vienna Society the two principal papers also relate to the East; one (a continuation) being on the Turkish Vilayet of the Islands, by A. Ritter von Samo, and the other being an important contribution to Turkish ethnology by Herr Carl Sax, Austrian Consul at Adrianople. The paper and map of the latter show both the race and religion and language of the various divisions of the country, three items which are often confounded.

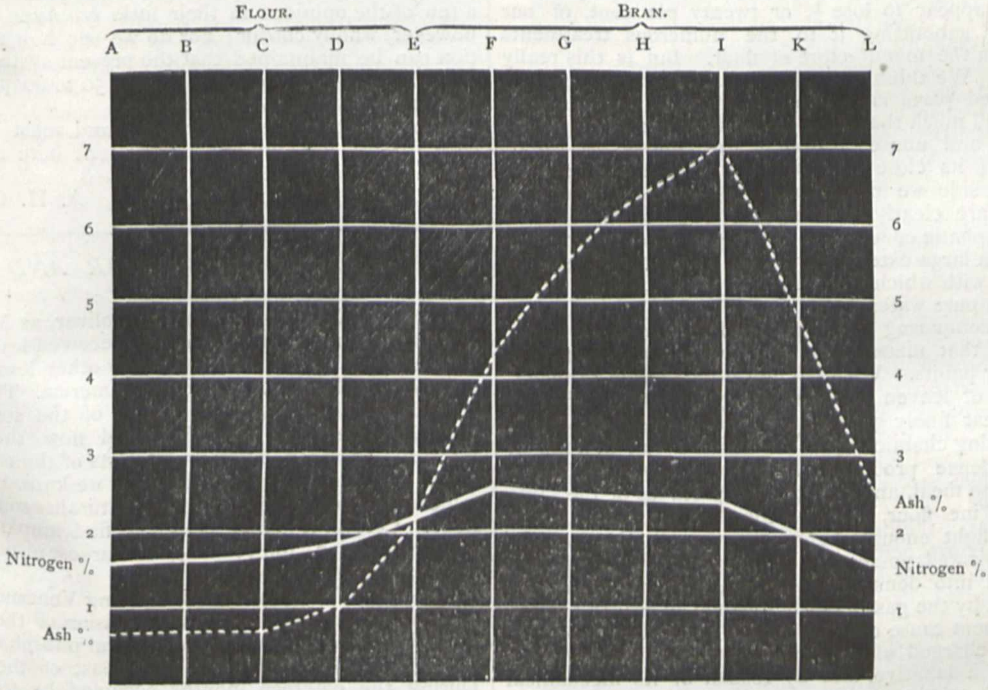
THE Japanese are certainly making great strides in the way of harbour improvement and the extension of means of inland communication, affording thereby a direct contrast to the exclusiveness and obstructiveness of the Chinese. The Doboku-Kioku (Bureau of Construction) now propose to construct a harbour at Samusawa in Miyagi, at a cost of 350,000 yen. It is also said that the Japanese Government desire to raise a home loan of 10,000,000 yen for the purpose of connecting Lake Biwa, in the province of Omi, by a canal with the river Uji, to bring the waste lands in the province of O-u under cultivation, and in order to connect Kioto with the Bay of Tsuga by railway.

REAL BROWN BREAD

NOTWITHSTANDING the labours of chemist and physiologist, the exact composition and nutritive value of the several products obtained in milling wheat have not been thoroughly determined. That fine flour contains less nitrogen, and leaves, when burnt, less ash than biscuit flour, middlings, or any variety of bran, is well known. The percentages of starch, of the mixture of cellulose and lignose known as "fibre," and of fat, in several series of samples of mill-products, have been ascertained. Moreover, there have been made many minute analyses of the ash of wheat and of the preparations derived from it. But we are still somewhat in the dark concerning both the chemical and physiological aspects of what may justly be regarded as the central feature of the problem under discussion. For we are not sure of the nature of the nitrogen compounds which exist in the several distinct parts of the grain of wheat; nor do we know how far the phosphates and such nitrogen compounds as may be ranked with the true albuminoids can be digested when intimately associated with fibre. Then, too, the mechanical condition of these coarser products from the milling of wheat is of considerable moment in estimating their actual value as nutrients.

Before endeavouring to reach some conclusion as to the comparative merits of white bread, brown bread, and whole-meal bread, I will offer in as compact a form as possible the more important and incontrovertible data which must form the starting-point of the discussion.

Firstly as to variations in composition in the grain itself. These variations, chiefly affecting the percentage of nitrogen, depend upon hereditary qualities in different strains of the wheat-plant; upon climate and season; and, to some extent, but not so largely as is often stated, upon cultivation, soil, and manure. The hard translucent wheats, *blés durs et glacés*, of high specific gravity, about 1·41, and, owing to their lengthened and wrinkled shape, of low weight per bushel, these wheats are rich in nitrogen. The soft opaque wheats, of less specific gravity, about 1·38, and, owing to their rounded and plump form, of high weight per bushel, these are poor in nitrogen.



The hard wheats grown in Poland, in Southern Russia, in Italy, and in Auvergne, are used in the manufacture of macaroni, vermicelli, semolina, and pâtes d'Italie. The softer and more starchy wheats are especially appropriate for the production of fine white flour. According to the most recent analyses, the percentage of nitrogen in different varieties and samples of air-dry wheat may range from 1·3 up to 2·5—numbers corresponding to 8·23 and 15·83, respectively, of gluten or flesh-forming substances. But the same variety of wheat may give a grain having 3 per cent. more gluten in a bad season than when matured in a fine summer. More than this, one may select from the same field, the same plant, or even the same ear, individual grains which shall show quite as wide a variation in gluten, as that just cited. For instance, a sample of Hallett's white rough-chaffed wheat of the harvest of 1865 contained many dense and translucent horny grains having 13·2 per cent. of gluten, while the white opaque soft grains from the same sample contained but 9·6 per cent.

It will simplify the consideration of the chemistry of mill-products if we confine our attention mainly to the nitrogen and ash of the grain. The following diagram represents the percentages of these two substances in a series of flours and brands derived from a good sample of English soft wheat. The figures are based in great measure upon the analyses made at Rothamsted by Dr. Gilbert. The mill-products termed A, B, C, are derived mainly from the central portion of the grain, and constitute "fine flour;" D is a biscuit flour known as "tailings;" E is intermediate between flour and bran, and goes under the name of "middlings;" F is "coarse sharps," G "fine pollard," H "coarse pollard," and I "long bran." K, or thin bran, is a product obtained in the process of decorticating wheat by attrition; while L is separated from the grain by moistening and then rubbing it, as in the method devised by Mège Mouriés. These two latter products may legitimately find a place in the series, since they represent the last terms as we proceed towards the outer coats of the grain.

The above table explains itself; we would remark merely that both nitrogen and ash are lowest in the four flours, and that the former constituent attains its maximum in F, the coarse sharps, and the latter in I, the long bran. In K and L both nitrogen and ash are lower, these products containing much cellulose, made up as they are in great measure of the three coats which form the pericarp of the grain. But it must not be forgotten that all the mill-products included under "bran" contain much more cellulose than is present in flour, namely :—from 7 to 15 per cent., or even more, in lieu of 1 per cent., or less. And it would appear that while flour contains more than 90 per cent. of its nitrogen in the form of true albuminoids or flesh-formers, in some of the brans one-third of their nitrogen is in the form of non-albuminous bodies, of no recognised value as nutrients.

We have now to secure but one more datum before we proceed to the determination of the main question before us. How much flour and how much bran will 100 parts of ordinary soft wheat yield on the ordinary system of low-milling adopted in England? As the averages from an immense number of independent estimates we may put down the flour at a total of 80, the bran at 17, and the loss at 3. Thus, from an economical point of view, we appear to lose $\frac{1}{5}$, or twenty per cent. of our wheat by submitting it to the numerous treatments involved in the manufacture of flour. But is this really the case? We think not. For much of the nitrogen in the rejected parts is not in the form of flesh-forming matter, and much that does so exists in the bran passes unaltered and unused through the alimentary canal, because of its close incorporation with fibre. But on the other side we must not forget that bone-forming materials are clearly deficient in wheaten flour, and that those phosphatic compounds present in bran are readily soluble to a large extent, not only in the several digestive secretions with which they come in contact in the body, but also in pure water.

But in comparing and contrasting bread made from flour with that made from whole wheat we must consider other points. We shall find it impossible to make, by means of leaven or yeast, a light spongy loaf from whole wheat finely ground, the so-called *cerealin* of the bran inducing chemical changes which result in a moist, clammy, dense product. Even whole wheat merely crushed into meal, and not ground, partakes of the same defect. Fine flour, on the other hand, yields a bread which is light enough before mastication, but which, when masticated, possesses a marked tendency to become compacted into dense lumps which may never become penetrated by the gastric and intestinal juices, and which are a frequent cause of constipation. Whole meal bread cannot be charged with this defect; indeed it acts medicinally as a laxative, and by reason of its mechanical texture is hurried rather too quickly along the digestive tract, so that the full virtue of such of its nutrients as are really soluble becomes in part lost. Yet there is no doubt that for many persons, especially those who have passed middle age and are engaged in sedentary occupations, whole wheaten meal in the form of bread, biscuits, scones, &c., forms an invaluable diet.

The following analyses may present some of the foregoing statements in a clearer light and may add some additional particulars of interest. They represent, so far as a couple of sets of average results can do so, the percentage composition of ordinary white bread and of the whole meal bread made by Mesrs. Hill and Son :—

	White.	Whole Meal.
Water	40·0	43·5
[1] Albuminoids or flesh-formers	7·0	[2] 10·5
Starch, dextrin, and sugar ...	50·7	40·6
Oil and fat	0·6	1·6
Cellulose and lignose	0·5	1·8
[3] Ash or mineral matter ...	1·2	2·0

1 Calculated from total nitrogen present.
2 As much as 12·5 in some samples.
3 Includes common salt added.

It is clear from the above figures that if we could reckon the whole of the nitrogenous matter in whole meal bread as equally effective with that contained in white bread, we should possess in the former a far more perfectly adjusted food; for the ratio of flesh-formers to heat-givers is about 1 to $7\frac{1}{4}$ in white bread, while it approaches 1 to 4 in some samples, at least, of whole meal bread. Add to this the higher proportion of phosphates in the latter, and its *chemical* superiority over white bread becomes still more marked : its flavour, too, is far richer.

One word as to ordinary brown bread will suffice. It is a poor preparation at the best. By adding a dash of rather rough bran to flour we do not obtain a satisfactory or rich product: analysis demonstrates this fact clearly.

We cannot leave this subject without referring to the little pamphlet which Messrs. Hill and Son have recently issued,[1] on the subject of wheaten meal. Though its main purpose is necessarily a commercial one, it presents many interesting and important facts in a readable form. Messrs. Hill have certainly brought their specialty in bread making some way on the road to perfection. With a few of the opinions in their little *brochure* we cannot, however, wholly concur; nor do we see how their assertion can be maintained that the present system of white bread making involves the loss of 50 to 60 per cent. of the wheat devoted to that purpose.

The limited space at our command must be our excuse for the very imperfect treatment here adopted of the wide subject before us.

A. H. CHURCH

THE LAND OF BOLIVAR AND ITS PRODUCTS[2]

VENEZUELA, or the Land of Bolivar, as Mr. Spence prefers to call it, has certainly received less attention from European travellers than many other less attractive and more explored parts of South America. The Andean ranges of the north and the llanos of the south of the republic alike merit attention, and now that mining enterprise has opened up several parts of the country and tinged it with European civilisation, we know of no more come-atable country to which the naturalist could turn his steps. Certain it is that he would find ample materials for investigation, and reap a good harvest of novelties in either fauna or flora.

Mr. Spence's main object in visiting Venezuela was, as it appears, the obtaining of a concession of the privilege of working certain deposits of mineral phosphates in the Roques Islands on the northern coast of the republic. During the eighteen months occupied by the delicate negotiations required for this purpose Mr. Spence seems to have lost no time. Although nominally resident at Caracas, in order to be in immediate communication with the ministers, frequent excursions were made to the most interesting of the surrounding districts. The coal mines of Nueva Barcelona, the Lake of Valencia, and the group of islands which were the seat of the wished-for concession, besides other localities of interest, were visited and explored. But the ascents of the Silla of Caracas and the still higher peak of Naiguatá, the crowning point of the Andean range between Caracas and the coast, appears to have been the principal expeditions to which Mr. Spence devoted his attention. The first

1 "The Whole Meal Bread Question." By W. Hill and Son, Bishopsgate Street.

2 "The Land of Bolivar: or, War, Peace, and Adventure in the Republic of Venezuela." By James Mudie Spence, F R.G.S. 2 vols. 8vo. (London, 1878.)
"Estudios sobre la Flora y Fauna de Venezuela." Por A. Ernst. 4to. (Caracas, 1877.)
'Estudios sobre las deformaciones, enfermedades y enemigos del Arbol de Cafe en Venezuela." Por A. Ernst. (Caracas, 1878.)
"On Venezuelan Birds Collected by Mr. A. Goering." By P. L. Sclater, M.A., F.R.S., and Osbert Salvin, M.A., F.R.S. (*Proceedings* of the Zoological Society of London, 1868–75. Five articles.)

recorded ascent of the Silla was made by Humboldt at the beginning of the present century, since when it has been climbed by several enterprising Venezuelans and by some foreign visitors. Mr. Spence effected the ascent in April, 1872, in company with the German naturalist, Goering, who was at that time collecting in Venezuela, and several private friends. The Silla having been successfully stormed, the summit of Naiguatá, which rises about 800 feet higher, was the next object. From the Silla, Mr. Spence tells us, this high peak "rose boldly to view, and the walled-in appearance of its flanks provoked not only curiosity, but an enthusiastic desire to overcome its traditional difficulty of ascent." Now Naiguatá was reputed to be inaccessible; there was a firm belief in Caracas that its summit "would never be trodden by human foot." There was even an old tradition which "proclaimed its impregnability," and all those who had attempted to scale the height had been compelled to abandon the undertaking without success.

Nothing daunted by the objections of the good people of Caracas, Mr. Spence and his friends set out on their expedition on April 21, 1872, and arrived, after some little difficulty, at the desired summit about midday next day. The Grand Precipice (see our illustration, Fig. 1) would not perhaps appear very formidable to an Alpine-clubbist, but under the tropics people are not so active or so venturesome as in these cold climes, and the retreat was rendered rather severe from the want of water, and the fog which rose up in the evening and obscured the way, as shown in Mr. Spence's drawing (Fig. 2). However, the deed was done, and amongst a small collection of Alpine plants brought from the summit, which has been since described by Dr. Ernst in the *Journal of Botany*,[1] was a new species of bamboo, named, after its discoverer, *Chusquea spencei*, in commemoration of the occasion.

Besides the account of his various expeditions and of his life at Caracas, many miscellaneous subjects regarding

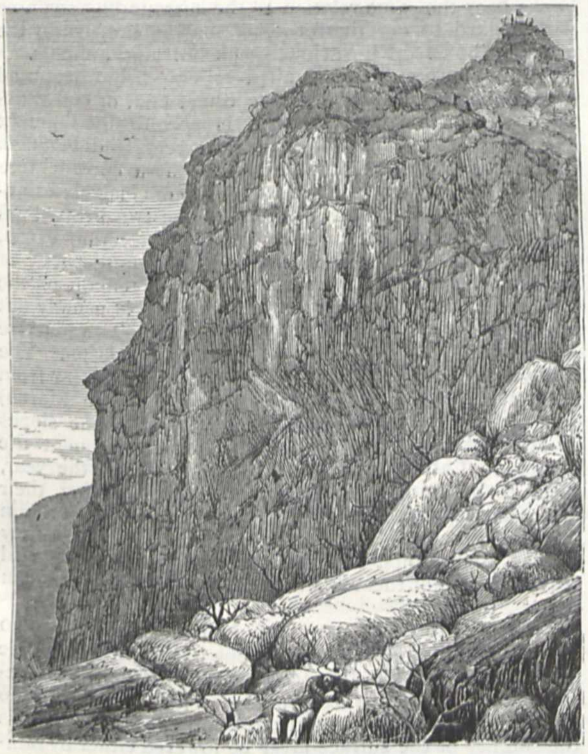


Fig. 1.—The Grand Precipice of Naiguatá.

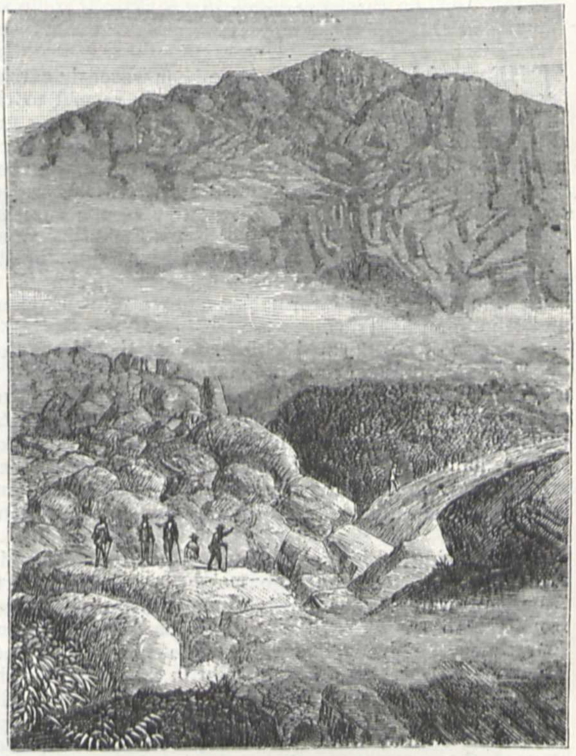


Fig. 2.—The Way lost on Naiguatá.

the "land of Bolivar" are treated of in Mr. Spence's volumes, and the appendix contains other details, amongst which is a synopsis of the orchids hitherto met with within the confines of the republic from the pen of Dr. Ernst. On the whole we may pronounce that Mr. Spence has done well in bringing the merits of a little-known part of the world's surface before the European public. Could Venezuela be persuaded to keep free from intestine dissensions, and to pay her debts a little more regularly, she might still make a figure among the American republics.

Along with Mr. Spence's volume two memoirs of Dr. Ernst, whose name we have already mentioned, lie before us. Dr. Adolf Ernst is, as his name betrays, a German who has deserted the Fatherland for Caracas, and is there labouring to grow science upon a somewhat uncongenial soil. In botany, zoology, and ethnology alike he has worked hard, and is the founder of the "Sociedad de Ciencias Fisicas y Naturales de Carácas," and, we believe we may add, the writer of the greater part of the memoirs of that learned association. His first "Estudios" contains general essays on the flora and fauna, and special catalogues of the ferns, orchids, birds, and land-molluscs of the republic. The second "Estudios" are devoted to a subject of primary importance in Venezuela, that is, to the maladies and enemies (animal and vegetable) of the coffee-plant—one of the staple-products of that part of America. This appears to have been written in answer to an appeal, from the scientific society above-mentioned, for the best essay on this absorbing question, and received the prize to which it was, no doubt, entitled, as having been written by probably the only individual in Venezuela who had more than empirical knowledge of the subject.

Finally we may remark that there is at least one

[1] "Notes on a Small Collection of Alpine Plants from the Summit of Naiguáta, in the Mountains of Caracas." By A. Ernst, Ph.D., &c. (*Jour. Bot.*, September, 1872.)

branch of the fauna of Venezuela that appears to have been pretty thoroughly worked at. Herr Anton Goering—the German naturalist, whose name has been already mentioned in connection with the ascent of the Silla of Caracas—sent all his collections of birds to this country, where they were examined and reported upon by two competent naturalists, who have devoted special attention to the neotropical avifauna. The results are given in the series of papers read before the Zoological Society of London, of which the titles stand last in our list of the subjects of this notice.

Mr. Goering's principal discoveries in the class of birds were made in the Andes of Merida, where some splendid novelties were obtained. And in this part of Venezuela, if we mistake not, there remains most to be done as regards both the fauna and the flora of the republic.

THE FISHERIES OF BRITISH NORTH AMERICA[1]

II.

THE careful inquiries that have been recently carried on by various able investigators in regard to the habits of our chief food-fishes—the Cod, the Herring, and the Mackerel—have now finally disposed of a large accumulation of popular fallacies on the subject of their migrations. On the European side Dr. G. O. Sars has added most to our scientific knowledge of the subject; and on the American, the United States Fisheries' Commissioner, Prof. Spencer Baird, and Mr. Hind, of the Halifax Fishery Commission, whose reports furnish a most valuable body of information as to the New England and Dominion fisheries.

It may now be affirmed with certainty that the notion of the long and distant migrations of these food-fishes is a complete mistake: the real facts being that they never range to any great distance from their ordinary *habitats;* that their migrations, which have reference to food on the one hand and to the deposit of spawn on the other, are simply from deep to coastal waters, and back again; and that these migrations are chiefly dominated by temperature.

Commencing with the *Cod,* we are informed by Mr. Hind that the total average weight caught in North American waters is about 185,000 tons, representing from 150 to 175 *millions* of fish, or between three and four times the produce of the whole Norwegian cod-fishery. Of this, the portion caught in the waters of the United States is only about one-fifth. "Winter cod" are taken on the southern coast of Newfoundland through the whole winter, while "summer cod" are captured through the summer months on the north-east shores of Newfoundland, the entire shore of the Gulf of St. Lawrence, and along the Labrador coast as far north as the Moravian missionary stations, Nain and Okak (57½° N. lat.).

It seems now well established that the great body of cod-fish inhabiting the waters of the long North American seaboard is divided into numerous separate "schools," which vary in their habits according to the localities they respectively frequent, each keeping (for the most part, at least) within its own limited range. There is no specific or even varietal difference between the "winter" and "summer" cod; their movements towards the coast from the neighbouring deeps, in which they spend the remainder of the year, being determined by the climatic changes which make the northern shores afford the temperature most congenial to the species in the summer months and the southern in the winter.

The food which lures the cod towards the shore at stated periods varies with the locality and season, being for the most part the capelin in the colder seas and the herring in the warmer; and hence the movements of these fish exert an important influence over those of the cod. At other times the chief food of the cod consists of the Invertebrates of the sea-bottom; and according to the predominance of any particular species will be its share in their maintenance. Thus in some places the cod feeds chiefly (as is shown by examination of the contents of the stomach) upon bivalve or univalve Mollusks; in others upon crabs, shrimps, and yet smaller Crustaceans; in others upon sand-stars, brittle-stars, holothurians, and other Echinoderms. The resort of cod to "banks" seems essentially determined by the food they find there; this, again, being dominated by temperature,—for, as already pointed out, the water on these banks is colder than water at the same depths elsewhere: many sub-arctic species of shell-fish, &c., which serve as food to the cod, thrive there far south of their ordinary habitats (as has been observed by Dr. J. Gwyn Jeffreys on the Dogger Bank); and thus, as Mr. Hind remarks, these banks bear the same relation to the surrounding sea area with regard to certain forms of marine life, as do the oases in the desert to various species of land animals.

An impression has prevailed among fishermen, and even among naturalists, that the Shore cod, or cod generally caught in coastal waters, is specifically different from the Bank cod, which is taken on reefs and banks in comparatively deep water, and often at a considerable distance from land. But it has been conclusively established by the careful observations of the two Profs. Sars (father and son) that no such specific distinction exists, the difference being one partly of age and partly of *habitat.* The two and three-year old cod remain on the Norwegian coast all the year round, and it is usually not until they attain their fourth year that their reproductive organs are sufficiently developed for multiplication. The adult Norwegian cod, according to Sars, retire far from the coast when the spawning season (January to March) is over; and are found during the summer on the slopes of the Polar Deeps. So the cod which frequent the coasts of Labrador through a great part of the year, seem to be immature (though sometimes having their reproductive organs developed); and when they attain their full growth, which occurs in their fourth year, they change their habits, frequenting the outside banks, and only a portion of them visiting the coast during the capelin season.

According to G. O. Sars, the Norwegian cod has no regular spawning ground, but drops its spawn free in the sea at a considerable distance above the bottom. The specific gravity of the ova is slightly below that of sea-water, so that the spawn rises to the surface and floats there, unless the salinity of the surface-layer be lowered either by rain- or by river-water, in which case the ova sink until they reach more saline water. The same is the case with the milt of the male, which seems to be shed at a greater depth than the roe of the female, which is thus impregnated from beneath, the micropyle of the ovum being located at its lowest point. The time required for hatching is about sixteen days, but a further period of fourteen days is required for the absorption of the yolk-bag, up to the completion of which process the young fish has little swimming power.

On the North American coast the spawning of the cod is not confined to a particular season, the process taking place in one locality or another through nearly, if not quite, every month in the year, and being obviously dominated by temperature, for it appears that cod ova find the *coldest* surface-water, provided it be free from ice, the most congenial to their development. Hence, as Mr. Hind justly remarks, the zone of cold water of from twenty-five to thirty miles broad, which extends for hundreds of miles along the Labrador coast, within the line of banks on which icebergs ground, is a most

[1] Continued from p. 172.

valuable possession to us, as supplying the most favourable conditions for the development of the cod ova furnished by the South Labrador schools, and thus feeding the great fishing-grounds further south.

Of late years the salted roe of the cod has become an important article of export, and the preparation of it a considerable industry, the principal use to which it is applied being for bait. Now in so far as this utilisation turns to account what was previously thrown away as offal, it is clearly an advantage; but it now leads to a special search for the gravid fish, which are taken in large quantities in shallow waters by seine nets, and in deep by the "bultow." This practice is very strongly reprobated by the United States Commissioner, who justly remarks that it is "precisely equivalent to killing off all the mature hens in a farm-yard before they have laid their eggs, and then expecting to have the stock continued indefinitely." "As well," he continues, "might the farmer expect to keep up his supply of wheat year by year while he consumed all his grain, reserving none for seed, and without the possibility of obtaining it from any other source." It is obvious from what has been already stated that the fisheries of New England must be much more injured by such a practice than those of the Dominion, the recruiting-ground of the former being far smaller in proportion; and it is also clear that the concession to the United States fishermen of the right to carry on this industry in British American waters is a very valuable one, and that, if made at all it should be placed under conditions which may prevent its being used to the detriment of our own fisheries.

The habits of the *herring* are in many respects different from those of the cod; for while the latter is essentially a bottom-feeding fish, the former is an essentially pelagian fish, feeding and swimming either at the surface or at any depth at which it finds its best supply of food. This consists sometimes of smaller fishes—sometimes the young of its own kind, but generally speaking of more minute animals, especially Entomostraca and Radiolaria, of which small reddish-brown aggregations, known to Norwegian fishermen as *aat*, are often found floating in the waters frequented by the herring. (I have myself met with these in considerable quantity near the Shetlands.)

The old notion of the annual migration of the herring from polar to southern waters has been long since abandoned, in favour of that which recognises in its movements an instinctive direction towards shallower waters at the spawning season. The eggs do not float, like those of the cod; but sinking in virtue of their greater specific gravity, attach themselves by their viscid envelopes either to the bottom or to anything else with which they come in contact. Ropes drawn through herring-spawn, or merely lying where it is deposited, become so thickly coated with it as to resemble large cables; and nets let down upon the spawning-grounds become so thickly covered, that in cleansing them the decks of the fishing-vessels are often ankle-deep in spawn. This spawn is very attractive to cod, which are thus lured towards the shore by the abundance of bottom-food left by the spawning "schools" of herring, as well as by the opportunity of preying on the schools themselves.

The productiveness of the herring fishery of the British North American coasts has been rapidly augmenting of late years, and seems likely to undergo a yet larger increase; for while it has hitherto been prosecuted only when the fish approach the coast at the spawning season, the knowledge now acquired of its habits will guide the fishermen where to look for it at other parts of the year, and how to take it at different depths. The limit set by temperature to the southern range of the herring has been already adverted to; and the admission of United States fishermen to British American fishing grounds is likely to become an even greater boon to them, in allowing them to prosecute a winter herring fishery along the coasts of Nova Scotia and Newfoundland, than it is in enabling them to participate in the cod-fishery. "The fluctuations in North American waters," says Mr. Hind, "are small in extent compared with those astonishing changes which take place in Europe, sometimes causing the ruin of large commercial and fishing communities, and leading to general distress. But the permanency of the herring schools in British American seas, the comparatively small size of the schools, and their uniform extent of distribution over an immense extent of coast-line, give them a direct and individual value to our fisheries, greater than is enjoyed even in Norway."

The spawning of the herring on British American coasts takes place partly in May and June (this being known as the "spring spawning"), and partly in August and September (the "autumn spawning"). The spring and autumn "schools" appear to be quite different; the period being determined in each case by the temperature of the waters frequented by the school. The spring spawning takes place with great regularity on the breaking up of the ice. The young when hatched school together, rarely going out to sea as far as their progenitors, and wintering by themselves apart from the older fish; not being found in any numbers in the deep bays of the coast of Newfoundland, Nova Scotia, and the northern part of Maine, where the old herrings winter. It seems probable that they do not begin to spawn until they have attained their third or fourth year. The depth at which the "spawning grounds" lie varies considerably—on the Norway coast, according to Boeck, from 10 to 150 fathoms. And there is good reason to believe that the occasional abandonment of old spawning grounds is usually due to a change of temperature, and that the fish is to be found at no great distance, probably in deeper waters.

"It is an important result of scientific inquiry," says Mr. Hind, "to ascertain the extent of the movements of a class of animals which have suddenly disappeared from accustomed haunts, and thrown into hopeless confusion an enormous industry upon which hundreds of thousands are dependent for their daily bread. But what immediate relief does it afford, if the discovery establishes the fact that the small downward movement into deeper water, or outward movement into less accessible wintering or spawning grounds, has placed them within reach of fishermen provided with the requisite means of capturing them?" In adapting themselves to such new requirements, he considers that the United States fishermen show more energy than those of New Brunswick; but if the latter allow themselves to be beaten in this winter fishing, in spite of the advantages given by nearer proximity to the fishing-grounds, it is of course their own fault.

The Norwegian herring fishery has of late suffered such a decline, while that of the North American coast has been improving, that out of the million of barrels, to which the catch of the latter is said to amount, no inconsiderable amount is now carried to Sweden in United States vessels. Another source of profit in the capture of the herring is the manufacture of an oil pressed from the bodies of the fish, and the use of the residual "scrap" as manure, under the name of fish-guano. And a vast number of freshly-caught herrings are used as bait in the cod and halibut fisheries; the United States fishermen resorting for this purpose to the Nova Scotia and New Brunswick fishing-grounds, as they find a more profitable market at home for the herrings which they catch off the New England coast. There is reason to fear that, unless due attention is given to the preservation of the spawning grounds, the New Brunswick herring-fishery will decline as that of New England has done; so that the activity of the United States fishermen will not only greatly injure British interests, but will in time come to defeat their own, if it be not placed under provident restraint. Not only the fishermen of the United States, but those of France also, are supplied with cod-bait from the Newfoundland herring-grounds; and from recent arrangements for storing the bait-fish in ice, the capture of herrings for this purpose is being carried on with increased vigour. "So urgent is the demand for bait, and so entirely dependent are the cod and halibut fisheries upon a sufficient supply, that the fisheries may be said to be altogether dependent upon its being available, either naturally or stored near at hand, in a fresh and suitable condition." "The importance of these facilities for procuring bait only stands out in its true relief, when compared with what would be the condition of affairs if the fishermen of the United States did not enjoy a sufficient supply."

The *Capelin* and *Launce*, also, though of comparatively little value as human food, are of great importance as bait-fishes; the former supplying the cod fisheries of Labrador (where they sometimes abound to such a degree that at the spawning season their shoals are often stranded along the shore), and coming south as far as the Grand Banks; whilst the latter often visit the Banks in such enormous numbers as to give to the sea quite a glittering aspect. The resort of capelin to the Newfoundland fishing-grounds is less regular than that of herring, and it has been found necessary, in order to prevent the destruction of this most important attraction to the cod, to prohibit the use of capelin as manure.

The *Mackerel* is another very important food-fish, which, though an inhabitant of the United States coast much further south than the herring, is especially abundant in northern waters, and has always formed an important component of the produce of the Dominion fisheries, the value of the catch in some seasons exceeding that even of the cod. The supposed migrations of the mackerel from warm southern waters to cooler seas during the summer months, like the mythical wanderings of the herring to polar seas during the winter season, or the equally fanciful migrations of the cod to spawning-grounds on the Norwegian coast, have disappeared before the test of rigid inquiry; the fact being that different schools of mackerel inhabit different parts of the western shore of the Atlantic, from Greenland to Cape Hatteras; wintering in deeper water, and approaching the shore in the spawning season. The time of this approach varies with the temperature of the locality, the fish making their appearance earliest in southern latitudes, and progressively later in the spring and summer in proportion as the latitude is higher and the temperature of the sea lower. The spawn is not deposited on the bottom like that of the herring, but floats on the surface like that of the cod; and the young, when hatched, seems to pass the earlier part of its life in coastal waters. Though the schools of mackerel wander a good deal in the summer months, their wanderings do not appear usually to extend far from their birthplace, and seem mainly to have reference to food-supply, which consists of small fish-fry, entomostraca, and other inhabitants of surface-waters, the relative abundance of which is greatly determined by prevalent winds, while the stratum in which they swim is mainly determined by temperature.

For this and other reasons not yet fully known, the fluctuations in the productiveness of the Mackerel fishery are much greater than those of the Cod and Herring fisheries, especially on the New England coast; and thus the unrestricted admission of United States fishermen to the Dominion waters is a privilege of great value, of which they have largely availed themselves. Mackerel-catching is a special industry, and requires sea-going vessels. The boat-equipment common throughout British-American waters is wholly unsuited to the pursuit of the mackerel, immense schools of which are frequently left unmolested in the Gulf and on the coasts of Newfoundland, in consequence of the fishermen being unprovided with suitable vessels and fishing-gear.[1] Hence the greater part of the mackerel fishery in these waters has hitherto been carried on by United States fishermen; but there is, of course, no reason, save a want of enterprise, why those of the Dominion should not prosecute it with equal success.

From all this it is clear that if the United States fishermen were limited to their own waters, they would speedily exhaust the supplies of the "commercial fish" required not merely for the supply of food to a vast population, but for the supply of bait, fish-oil, and fish-guano—together constituting a drain which far exceeds the natural resources of the limited area along the United States coast inhabited by the cod and other deep-sea fish, as is fully admitted by Prof. Spencer Baird, the United States Commissioner. And thus the free admission of United States fishermen to the fisheries of the Dominion, which are not only unexhausted but apparently inexhaustible (if only placed under reasonable restrictions), is a privilege of enormous value, which should be met on the other side in a spirit of fair reciprocity.

How far this spirit has been exhibited on the part of the Legislature of the United States—which, after agreeing to an arbitration for the settlement of the amount to be paid in compensation, is now raising technical objections to the award, and protesting strongly against its justice,—is not a matter for our consideration; but we cannot conclude without adverting to one point which seems to have received insufficient attention.

While the coastal waters of the United States are in great measure unfitted by temperature for the maintenance of the "commercial" fishes, they are peculiarly adapted for the natural growth and artificial production of different species of shell-fish; some of which are chiefly useful as bait, whilst the Oyster not only supplies the wants of American consumers, but has become a large article of export. The Oyster-industry in the United States now far exceeds in value the aggregate of the deep-sea fisheries; its head-quarters being Chesapeake Bay, "a magnificent basin in which Providence seems to have accumulated every necessary condition for forming an admirable locality for the fishery," so that the oysters inhabiting it do not need culture, but are at once fit for the market. The transport of these oysters to the Northern and Eastern States employs quite a fleet of schooners; and the amount of oyster-shells calcined for lime is almost incredible, the profit derived from the shells at Baltimore alone amounting in 1857 to more than 120,000 dollars.

Now the Treaty of Washington having limited the taking of shell-fish to the citizens of the nationality in which they are found, British American fishermen are completely excluded from the Oyster-industry of the United States, without possessing any corresponding advantage; for the temperature and other conditions of the Dominion coast are just as *un*favourable to the growth of oysters and other esculent shell-fish, as those of the United States coast are favourable; so that, as its produce has no commercial value, "the reciprocity is all on one side."

The different fisheries of the United States coast have been long pursued with the ability and energy which distinguish the American people; but it has been clearly pointed out by the officers employed both by the United States Government and by the several States' Governments, that a decline in the productiveness of the fisheries has of late been going on along the greater part of the coast, and that this decline is due to excessive capture, especially of spawning fish. Through the obstruction and

[1] It is worth notice that the abundance of mackerel on the north-east coast of Newfoundland was for many years so great, that the fish were not only used for manure, but gave such trouble to the fishermen engaged in the cod and herring fishery, that their subsequent diminution was attributed by the fishermen to their having been "cursed off" the coast.

pollution of the New England rivers, the lumberer and manufacturer have ruined the cod-fishery of that locality by destroying the anadromous fishes which attracted the cod thither; so that thus the "fish oil" and "fish guano" manufacturers, who are now enriching themselves, not only at the expense of the herring and menhaden, but of the other species which depend on these for food, will speedily, if unchecked, increase the depletion of the northern waters of the United States; thus increasing the value of the concession made by the Treaty of Washington, and rendering it still more important that laws should not only be made, but enforced, for the prevention of a similar depletion of the (at present) highly productive fishing-grounds of the Dominion.

WILLIAM B. CARPENTER

THE GEOLOGY OF LONDON[1]

ALTHOUGH the British Government have undertaken the geological survey of the country, yet the valuable results obtained by this survey are unfortunately allowed to remain almost unknown to the general public. A complete set of the publications of the geological survey costs, we believe, something like 130*l.*, and is, of course, quite out of the reach of all but great libraries and wealthy public institutions, and no authorised reductions of the maps have as yet been published. It is much to be regretted, too, that the illiberal parsimony displayed in some branches of our public service is most conspicuous of all in that scientific department of it, where its effects prove most injurious. While the publications of the American geological surveys are distributed in foreign countries with an open-handed liberality worthy of a great government, and the courtesy of the chiefs of those surveys, Dr. Hayden and Mr. Clarence King, is well known to everyone—it is notorious that the directors of our own survey are placed in the painful position of having to refuse to acknowledge the just claims of the largest and most important scientific institutions of their own and other countries. The directors of our national surveys are the more to be pitied, inasmuch as the position of grudging parsimony in which they are placed contrasts so strikingly with that course of wise and judicious liberality in making known the results of their labours which the officers of the scientific departments of the United States and some other countries are permitted to pursue.

Another matter calling for serious consideration on the part of those who manage the publication of the results of these national surveys, is the exorbitant prices so often charged for the maps and memoirs. We know not whether it be the result of mismanagement or something worse, but it is a fact that it would seem to cost this Government department three or four times as much to produce a map or memoir as a private firm would require to accomplish the same work. Surely these publications not being handicapped with the charges of authorship, ought to be alike marvels of cheapness and models of excellence, yet how very different is the fact! For an unmounted one-inch map of the district around London the public is charged thirty shillings; for very moderate-sized volumes printed on inferior paper and having the general aspect of mean blue-books put into cloth covers, the sum demanded is two pounds; and recently the geological survey has surpassed even itself by issuing a small paper-covered pamphlet at the price of seventeen shillings!

None suffer so much from the effects of this unwise parsimony and obvious mismanagement as the officers of the survey itself. Those among their number who are engaged in active scientific work see the results of their labours, after long delays and many vexations, placed before the public in an almost inaccessible form; and they are too often disappointed and discouraged by finding that they do not receive the credit which their persevering labours so well deserve. Possibly, as has frequently happened, an amateur observer working independently, and untrammelled by the chains of officialism, is able to forestall their results, by publishing in a scientific journal the most important of their conclusions. Have not the directors of these surveys yet learnt that the day is gone by, when scientific writings can with impunity be delayed for years in the press?

Fortunately the evils to which we have directed attention in the foregoing paragraphs have a tendency to work their own cure. Thus, though the English Government have not followed the wise example of Austria in publishing chromo-lithographed reductions of the larger maps, the director-general and the directors of the branch surveys have produced privately useful maps on a reduced scale of the areas of which they respectively have charge. Objectionable as it may seem in principle that Government officials should issue as private speculations these results of their labours, it is certainly better that they should be allowed so to do, than that the public should be altogether deprived of such important publications.

The map of which the appearance has prompted the foregoing remarks, is another example of private enterprise being allowed to take in hand what we might fairly expect to be accomplished by a national institution. At the Loan Exhibition of Scientific Apparatus, in 1876, a MS. map of the geology of the district around London, drawn on the scale of six inches to the mile, attracted much attention. Since that time this map, with a well-constructed model of the same area, has formed one of the attractions of the admirable museum at Jermyn Street. In this instance the wise course was adopted of publishing a cheap "Guide to the Geology of London," which was drawn up by Mr. Whitaker, one of the most active and efficient officers of the survey, and a geologist whose researches are well known to scientific men beyond its limits. We believe that this excellent little book has had the large circulation it so well deserves; and it is certainly much better calculated to attract the attention of the general public to the important work that is being carried on by the Geological Survey than some of the more ponderous volumes, of which only a few copies are sold at very high prices in each year.

But valuable as the information on this six-inch map clearly was to a large section of the public, its information has been allowed to remain unpublished, and now Mr. Stanford has had to step in to supply the deficiency. Taking advantage of his excellent and well-known library map of London, and securing the services of Mr. James B. Jordan, who has had so much experience in work of this character, he has issued the geological information in question in a very convenient form. The map embraces all the area from Finchley on the north to Beckenham on the south, and from Blackheath on the east to Shepherd's Bush on the west. The subdivisions of the superficial deposits are not so numerous as might possibly have been desired on a map of this large scale, and the work shows too evident traces of having been compiled from a variety of different sources, some of the areas having been carefully surveyed on the six-inch scale, while others are only enlargements of the one-inch map. Nevertheless, with all these drawbacks the map furnishes information not to be obtained from any other published source, and it will supply a want that was beginning to be extensively felt among the ever-growing population of the metropolis.

The colours of the map are exceedingly well chosen and tastefully combined. Until it is superseded by an authoritative Government publication on the same scale, it is sure to have an extensive circulation.

[1] Stanford's Geological Map of London and its Suburbs. The Geology compiled from the Maps and other Works of the Geological Survey of England and Wales by James B. Jordan. Size, 76 inches by 65. Scale, 6 inches to a mile. (London: Edward Stanford, 1878.)

NOTES

THE following is a list of the officers of the Forty-eighth Annual Meeting of the British Association, which will, as we have intimated, commence at Dublin on Wednesday, August 14, 1878. President Elect—William Spottiswoode, LL.D., F.R.S. Vice-presidents Elect—The Right Hon. the Lord Mayor of Dublin, the Provost of Trinity College, Dublin, His Grace the Duke of Abercorn, K.G., the Right Hon. the Earl of Enniskillen, D.C.L., F.R.S., the Right Hon. the Earl of Rosse, D.C.L., F.R.S., the Right Hon. Lord O'Hagan, M.R.I.A., Prof. G. G. Stokes, D.C.L., LL.D., Sec.R.S. General Secretaries—Capt. Douglas Galton, C.B., D.C.L., F.R.S., Philip Lutley Sclater, Ph.D., F.R.S. Assistant General Secretary—G. Griffith, M.A., Harrow. General Treasurer—Prof. A. W. Williamson, Ph.D., F.R.S. Local Secretaries—Prof. R. S. Ball, LL.D., F.R.S., James Goff, John Norwood, LL.D., Prof. G. Sigerson, M.D. Local Treasurer—T. Maxwell Hutton. The following are the presidents of sections:—A.—Mathematical and Physical Science.—President: The Rev. Prof. Salmon, D.D., D.C.L., F.R.S. B.—Chemical Science.—President: Prof. Maxwell Simpson, M.D., F.R.S. C.—Geology.—President: John Evans, D.C.L., F.R.S. D.—Biology.—President: Prof. W. H. Flower, F.R.S. Department of Zoology and Botany: Prof. W. H. Flower, F.R.S. (president), will preside. Department of Anthropology: Prof. Huxley, Sec.R.S. (vice-president), will preside. Department of Anatomy and Physiology: R. McDonnell, M.D., F.R.S. (vice-president), will preside. E.—Geography.—President: Prof. Sir Wyville Thomson, LL.D., F.R.S.L. & E. F.—Economic Science and Statistics.—President: Prof. J. K. Ingram, LL.D. G.—Mechanical Science.—President: Edward Easton, C.E. The first general meeting will be held on Wednesday, August 14, at 8 P.M., when Prof. Allen Thomson, M.D., LL.D., F.R.S.L. & E., will resign the chair, and William Spottiswoode, M.A., LL.D., F.R.S., F.R.A.S., F.R.G.S., president elect, will assume the presidency, and deliver an address. On Thursday evening, August 15, at 8 P.M., a soirée; on Friday evening, August 16, at 8.30 P.M., a discourse by G. J. Romanes, F.L.S., on Animal Intelligence; on Monday evening, August 19, at 8.30 P.M., a discourse by Prof. Dewar, F.R.S., on Dissociation, or Modern Ideas of Chemical Action; on Tuesday evening, August 20, at 8 P.M., a soirée; on Wednesday, August 21, the concluding general meeting will be held at 2.30 P.M. Excursions to places of interest in the neighbourhood of Dublin will be made on Thursday, August 22.

THE following are the presidents of the numerous sections of the French Association which meets at Paris August 22-29:—Sections 1 and 2. Mathematics, Astronomy, Geodesy, and Mechanics, M. Collignon; 3 and 4. Navigation, Civil and Military Engineering, M. L. Reynaud; 5. Physics, Prof. A. Cornu; 6. Chemistry, Prof. Wurtz; 7. Meteorology and Terrestrial Physics, M. Hervé-Mangon; 8. Geology, Comte de Saporta; 9. Botany, Prof. H. Baillon; 10. Zoology and Zootechny, Prof. de Quatrefages; 11. Anthropology, Prof. Bertillon; 12. Medical Sciences, Prof. Teissier; 13. Agriculture, Baron Thenard; 14. Geography, M. Maunoir; 15. Political and Statistical Economy, M. Fréderic Passy.

THE Paris Academy of Sciences has at last succeeded in sending a list of candidates to the Ministry of Public Instruction to fill the place vacated by the death of M. Leverrier. The Academy suggests, by a large majority, the appointment, in the first place, of M. Faye, but M. Faye persists in declining any appointment. In the second place the Academy places the name of M. Loewy, one of the astronomers of the Observatory. M. Loewy being an Austrian by birth, it cannot be said that the Academy has been influenced by any prejudice of nationality. The other candidates presented by the Council of the Observatory are, in the first line, Capt. Mouchez, and in the second MM. Loewy and Tisserand *ex æquo*. It is not yet known what the minister will do. He is at liberty to appoint any other astronomer who has shown himself qualified for the exalted position, as we have announced. M. Mascart has already taken possession of his post at the Observatory as being at the head of the meteorological bureau, but although the principle of separating astronomy and meteorology has been decreed, they are making at the observatory active preparation to fit up new offices for the meteorological bureau. Both services are to be separated, officially and financially, but are to be lodged in the same building as they were during Leverrier's rule. The formal opening of the Meteorological Pavilion at the Exhibition took place on Monday.

THE Anniversary Meeting of the Sanitary Institute will be held at the Royal Institution, Albemarle Street, on Wednesday, July 3, at 4 P.M., when an address will be delivered by Mr. Frank T. Buckland, on "The Pollution of Rivers and its Effects upon the Fisheries and the Water Supply of Towns and Villages." The Annual *Conversazione* of the Members and Friends of the Institute will be held on the same evening at 8 o'clock, at the Grosvenor Gallery, New Bond Street. The Autumn Congress and Exhibition of the Institute will be opened at Stafford on Wednesday, October 2, 1878. The members of the Institute have been invited to the International Congress of Hygiène, under the patronage of the French Government, which will be held at Paris during the first ten days in August, 1878.

WE commend to our readers a movement which has been set on foot for the presentation of a testimonial to Mr. P. Le Neve Foster, the secretary of the Society of Arts, upon the occasion of his completing his twenty-fifth year of service as chief executive officer. When Mr. Foster became its secretary the society numbered only about 1,000 members. At the present time it now numbers about 4,000. During the period of Mr. Foster's administration the Society has successfully dealt with many important public questions, including those of elementary and technical education, patent and copyright law reform, international exhibitions, public health, Indian and colonial and many other topics. Upon these grounds an appeal is made to the members of the Society and the public for their co-operation. An influential committee has been formed, with Lord Hatherley as president.

WE notice the death, in Nürnberg, on June 5, of Baron Ernst von Bibra, in his seventy-second year. Baron von Bibra presented an interesting instance of a cultured nobleman devoting himself entirely to science and letters, and attaining distinction in both branches—a type of character not altogether uncommon in England, but much more rarely encountered in Germany. After the completion of his university studies at Würzburg, he carried out at his castle in Franconia a series of chemical researches which, especially from a physiological point of view, attracted considerable attention. Among these were "Chemical Investigation of Various Purulent Matters" (1842); "Chemical Investigations on the Bones and Teeth of Mankind and the Vertebrates (1844); "Physiological Action of Phosphorus on the Workmen in Match Factories," "Action of Ether" (1847); "Chemistry of the Liver and Gall" (1849); and "Composition of the Blood of the Lower Animals" (1849). In 1850 he undertook an extensive tour through South America. On his return he published analyses of sea-water collected from a variety of points in the Atlantic and Pacific. These were followed in 1853 and 1854, by valuable monographs on the "Composition of the Brain, Spinal Marrow, and Nerves;"

"Action of Narcotics on the Human System;" and "Contributions to the Natural History of Chili;" and in 1858-60, by researches on cereals and coffee. At this period von Bibra turned his attention more especially to *belles-lettres.* The record of his travels in South America was followed by works of fiction, and in a short time he won a prominent place among the German novelists of the day. So fruitful was his pen that no less than fifty-one volumes of novels and tales appeared under his name from 1861-73. Despite this degree of literary activity, the claims of science were not entirely neglected. Papers appeared from him at intervals on various South American minerals, on the chemical composition of various German geological formations, on the properties of aluminium, on a bismuth tin-lead alloy nearly as fusible as Rose's metal, on methods for regaining silver from the solutions of the cyanid, &c. Of more importance were two chemico-archæological monographs "On the Bronze and Copper Alloys of Antiquity" (1869), and "Ancient Iron and Silver Work" (1873). A paper "On the Restoration of Ancient Manuscripts and Paintings" which appeared during the present year, was lately alluded to in these columns. Baron von Bibra was a corresponding member of the Vienna Academy, and several other German academies.

THE State Museum of Sweden has suffered a severe loss through the death of Prof. C. Stål, which occurred on the 14th inst., after a few days' illness; Prof. Stål was only 45 years of age. He was keeper of the Entomological Department of the Museum, to the maintenance of which he devoted an unusual activity and diligence. He is widely known in the scientific world as the author of many important papers on hemiptera and orthoptera, to the systematising of which orders he chiefly contributed. He has been snatched away before his time from other works unfinished and from a large circle of friends who deeply deplore the decease of the amiable and faithful man.

WITH the formation of international exhibitions like that now attracting the world's notice at Paris, there are placed on record, in the form of catalogues, lists of all, or nearly all, the contents of an immense building. These contents are, as it is intended they should be, of a very varied character. The catalogues themselves being the productions of different sections or departments and of widely different nations, consequently we might expect some difference of character in the preparation of these "Guides." Too often a bulky book is produced which is nothing more than a mere list of exhibitors' names and addresses, of no use to the visitor while in the exhibition, and of still less use for reference after. Thus, for instance, opening promiscuously the catalogue of the British Section of the present exhibition, our eye rests on the name of a well-known firm of manufacturing chemists, but all the information we obtain about their exhibits is "Pure Chemicals and Pharmaceutical Products." The Australian colonies have hitherto distinguished themselves in producing full and descriptive catalogues which have been worth a place in the library not only as records of each great show, but as books of reference on the products of the Colonies. We are glad to find that our Indian exhibits are being treated in a somewhat similar way, for we have before us a "Catalogue of the Raw Products of Southern India Collected and Forwarded (under orders of the Government of Madras) to the Paris International Exhibition of 1878." This Catalogue has been prepared by Dr. G. Bidie, the Superintendent of the Government Central Museum at Madras, and comprises substances used as drugs, for food, and in manufactures. Forest products, such as woods, are excluded from this catalogue for the reason that their collection and exhibition has been made a specialty by the Forest Department, a catalogue of which has been drawn up under the title of a "Catalogue of Specimens of Timber, Bamboos, Canes, and other Forest Produce from the Government Forests in the Provinces under the Government of India and the Presidencies of Madras and Bombay." Returning to the first-named catalogue we have an exceedingly well drawn up handbook of 136 pages divided into three great divisions of drugs, food substances, and substances used in manufactures, each being lettered in red on the margin for easy reference. These primary divisions are subdivided into products of the vegetable, animal, and mineral kingdoms, and, in the case of the drugs, again subdivided into such as are officinal in the Pharmacopœia of India, those not officinal, but described in the Pharmacopœia, and those not included in the Pharmacopœia. Again, amongst foods we have agricultural produce, such as cereals, pulses, &c., fruits and seeds, substances used in the preparation of drinks, &c., and so on through each great division. The genera of plants are arranged under each natural order, and, being printed in black letters, are very easily found. After the Latin name follows the English, French, German, and other vernaculars. The plan of the book is, in short, founded on Bridwood's "Economic Products of Bombay," with many improvements. From the catalogue of specimens of timber, bamboos, &c., we find that as many as 650 different specimens of woods have been sent from India to the Exhibition, the total number of specimens of woods and other products of trees amounting to 1,055, which, at the close of the Exhibition, are to be presented, by order of the Indian Government, to the French National School of Forestry at Nancy, "where," as we read, "for ten years past a large proportion of the forest officers of India have received their professional education."

M. DE LESSEPS has inaugurated at the Paris Exhibition a series of lectures, which will be given on Saturdays at two o'clock in the Egyptian House erected by the Suez Company and the Egyptian Government. This house has been built from designs by Mariette-Bey, and professes to represent the mansion of a noble Egyptian at the end of the thirteenth dynasty, before Abraham was born. It consists of a court and a number of rooms. In one of the largest has been placed a model of the Suez Canal and a bird's-eye view of the delta and the Isthmus. M. de Lesseps explained the great work of boring the canal, the actual state of the lands of the Company and the influence of the salaries paid to natives during the execution of the works. A second lecture by M. de Lesseps was delivered in the second hall, where has been hung an immense map of Africa as at present known. Relics of Livingstone, his books, instruments, cap, &c., have been disposed in the room as well as objects connected with the natural history, industry, and trade of the lake region. M. de Lesseps lectured on the necessity of supporting the International Society for the Civilisation of Africa, and on the results accomplished by the Egyptian Government in taking possession of the banks of the Nile from 31° to 1° N. lat.

A CONGRESS of Demography will be held at the Trocadero Palace from July 5 to 9 to discuss the following topics:—Census of population, registers of population, organisation of statistics, registration of births and deaths, publication of periodical demographical results relating to large cities, emigration, &c. A Congress of Anthropological Science well be held in the same place from July 15 to 17. The programme consists of old things adorned with new names, such as ethnodicée, ethnogenie, &c.

LET not those of our mathematical readers who are rather shaky in their French be misled by a letter in Saturday's *Times* from the editor of the *Journal des Géomètres*, inviting English *géomètres* to a conference to be held in Paris on July 8 and 9. The context seems to show that the French word *géomètres* has really its original Greek signification of "land-measurer," and corresponds more nearly to English "surveyor" than anything else, the exact French term being, we believe, *Arpenteur-géomètre*. As the Paris *Daily News* correspondent showed the other day, even good French scholars may make themselves ludicrous to a Frenchman by translating words literally into their corresponding French forms, such as *physicien* and *chimiste*, which, we need hardly say, mean not physician and pharmaceutical chemist, but physicist and scientific chemist.

A GENERAL meeting of the Mineralogical Society of Great Britain and Ireland will be held at the Meteorological Office, 116, Victoria Street, on July 4, at 8 P.M., when the following papers will be read:—"On a New Manganesian Garnet," by Prof. M. F. Heddle.; "On Cotterite, a New Variety of Quartz," by Prof. Harkness; "On Youngite," by Messrs. David Stewart and J. J. Hood, communicated by Mr. J. B. Hannay; "Notes on Cornish Minerals," by Mr. J. H. Collins.

THERE is every prospect at present of the early commencement of another of the gigantic engineering enterprises characteristic of our century. The last steamer from Panama brings news of the ratification of the contract between the Government of Columbia and the International Committee for the Construction of a Canal across the Isthmus of Darien. Among the conditions we notice the clause declaring the future canal to stand open to the commerce of the entire world, and to be entirely neutral. Another condition is the completion of the work before 1895, but we fear that only pronounced optimists will look forward to the fulfilment of this clause. The Canal Company receives a grant of land including stretches 200 yards wide on each side of the canal, and over 1,000,000 acres in addition, to be chosen at will. It has besides the free use of all building materials on the isthmus, so that no complaint can be made of a lack of readiness on the part of Columbia to further the undertaking.

M. BARDOUX has opened at the Palais du Champ de Mars the Exhibition connected with Public Instruction. The minister said in his address that, owing to the recent progress of France, that country was now inferior to no other European nation as regards popular education. The results of the last conscription are highly satisfactory in this respect. Out of 294,382 men admitted into the ranks of the French army in 1877, only 4,992 were unable to read or write, 2,620 had taken their preliminary degrees in letters or sciences, 234,279 knew the "three R's," 36,325 could only read and write, and 5,856 could only read. Elementary schools have been established in the various regiments of the French army for years, but the attendance, which had been very limited, is now almost universal. Not less than 305,989 soldiers were pupils of regimental schools in 1877; out of these, 255,380 followed the course of elementary instruction, 36,981 the secondary course, and 4,682 the course of superior instruction. The army has been turned into a machine for promoting elementary knowledge. In 1877 not less than 33,337 soldiers learned to read, 24,483 to write, and 111,303 were taught arithmetic. Under guidance of their officers, 200 soldiers from the garrisons of Paris visit the Exhibition daily.

THE Emperor of Germany has named Prof. von Brücke, of Vienna, and the mathematician, C. Hermite, of Paris, as knights of the Order of Merit for Science and Art.

THE well-known physicist, Prof. Clausius, of Bonn, has been elected a member of the Swedish Academy of Sciences.

M. G. A. SIX has lately written a history of the progress of botany in Holland, a work for which this little kingdom has certainly furnished rich material during the past two centuries.

AN interesting fact for agriculturists is communicated by Herr Rudolf Mayerhöffer, of Prague, the editor of the agricultural serial, *Der Bienenvater aus Böhmen*. It appears that a German colonist upon the Island of Java has successfully tried the cultivation of the native bee, *Apis dorsata*, which hitherto has been valued by the natives only for the sake of the larvæ. Herr Mayerhöffer even expresses the hope that it will be possible to acclimatise the Javanese bee in Europe.

ON July 1 Prof. Victor Carus will bring out the first number of a new serial entitled *Zoologischer Anzeiger*, which will form a sort of zoological record in monthly instalments, and, to a certain extent, will be the continuation of Carus and Engelmann's invaluable "Bibliotheca Zoologica." Engelmann of Leipzig is the publisher. The new serial will contain communications regarding museums, institutions, and private collections, notes on zoological and biological subjects, besides a quantity of generally interesting scientific matter.

THE *Japan Times* understands that for the Hong-Kong "afforestation" scheme considerable quantities of seed have lately been forwarded thither at the request of the authorities. As much as will furnish a quarter of a million trees has been sent, the varieties being the *sugi*, *kinoki*, and *tsubaki* (the wild, single-flowered camellia).

PROF. FRÜS, of Christiania, who has been engaged for years in the preparation of a complete dictionary of the Lapp language, has nearly brought his work to a conclusion. This language is richer than most of the northern tongues, the first eleven letters of the alphabet embracing not less than 12,000 words.

THE Harvey Tercentenary Memorial Fund is so far advanced that it has been resolved to take steps to select a sculptor to whom the execution of the memorial statue should be intrusted. Of 1,680*l*. subscribed, 1,228*l*. are in hand.

A MANATEE, caught at the mouth of the Essequibo River, British Guiana, is now on view at the Westminster Aquarium. The poor "whale" has gone the way of its predecessor.

M. A. COSSA has recently communicated to the Academia dei Lincei the results of extensive litho-chemical investigations on the Island Volcano, north of Sicily. He has succeeded in finding here considerable quantities of the sulphates of the rare metals lithium, thallium, cæsium, and rubidium, apparently in the form of alums. The metals appear to have been present in the rocks surrounding the crater, as silicates, and the latter have been decomposed by the acid vapours mounting from the interior of the volcano. Hitherto the mineral pollux scattered over the Island of Elba has been the most abundant source of cæsium and rubidium.

THE additions to the Zoological Society's Gardens during the past week include a Pig-Tailed Monkey (*Macacus nemestrinus*) from Java, a Scarlet Ibis (*Ibis rubra*), a Red-Billed Tree Duck (*Dendrocygna autumnalis*) from South America, presented by Mr. R. M. Hyde; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. Samuel Curtis; an Indian Gazelle (*Gazella bennetti*) from India, presented by Miss Statter; two Prairie Marmosets (*Cynamys ludovicianus*) from North America, presented by M. J. N. Cornély; three Common Cormorants (*Phalacrocorax carbo*), British Isles, presented respectively by Mr. Edward Banks and Mr. W. Thompson; two Cereopsis Geese (*Cereopsis novæ-hollandiæ*), two Australian Sheldrakes (*Tadorna tæniatus*) from Australia, a Yellow-Billed Sheathbill (*Chiornis alba*) from Antarctic America, purchased; two Mantchurian Crossoptilons (*Crossoptilon mantchuricum*) from China, received in exchange; two Argus Pheasants (*Argus giganteus*), four Summer Ducks (*Aix sponsa*), four Chiloe Widgeons (*Mareca chiloensis*), three Australian Wild Ducks (*Anas superciliosa*), bred in the Gardens.

ON THE PHYSICAL ACTION OF THE MICROPHONE[1]

IN the paper read on May 9 before the Royal Society I gave a general outline of the discoveries I had made, the materials used, and the forms of microphone employed in demonstrating important points. I have made a great number of microphones each for some special purpose, varying in form, mechanical arrangement, and materials. It would require too much time to describe even a few of them, and as I am anxious in this paper to confine myself to general considerations, I will take it for granted that some of the forms of instrument and the results produced are already known.

The problem which the microphone resolves is this—to introduce into an electrical circuit an electrical resistance, which resistance shall vary in exact accord with sonorous vibrations so as to produce an undulatory current of electricity from a constant source, whose wave-length, height, and form shall be an exact representation of the sonorous waves. In the microphone we have an electric conducting material susceptible of being influenced by sonorous vibrations, and thus we have the first step of the problem.

The second step is one of the highest importance: it is essential that the electrical current flowing be thrown into waves of determinate form by the sole action of the sonorous vibrations. I resolved this by the discovery that when an electric conducting matter is in a divided state, either in the form of powder, filings, or surfaces, and is put under a certain slight pressure, far less than that which would produce cohesion and more than would allow it to be separated by sonorous vibrations, the following state of things occurred:—The molecules at these surfaces being in a comparatively free state, although electrically joined, do of themselves so arrange their form, their number in contact, or their pressure (by increased size or orbit of revolution), that the increase and decrease of electrical resistance of the circuit is altered in a very remarkable manner, so much so as to be almost fabulous.

The problem being resolved it is only necessary to observe certain general considerations to produce an endless variety of microphones each having a special range of resistance.

The tramp of a fly or the cry of an insect requires little range, but great sensitiveness, and two surfaces therefore of chosen materials under a very slight pressure, such as the mere weight of a small superposed conductor, suffice; but it would be unsuitable for a man's voice, as the vibrations would be too powerful, and would, in fact, go so far beyond the legitimate range, that interruptions of contact amounting to the well-known "make and break" would be produced.

A man's voice requires four surfaces of pine charcoal, as is described in my paper to the Royal Society, six of willow charcoal, eight of boxwood, and ten of gas carbon. The effects are, however, far superior with the four of pine than with either the ten of gas carbon or any other material as yet used. It should be noted that pine wood is the best resonant material we possess; and it preserves its structure and quality when converted into the peculiar charcoal I have discovered and described.

It is not only necessary to vary the number of surfaces and materials in accordance with the range and power of the vibrations, but these surfaces and materials must be put under more or less pressure in accordance with the force of the sonorous vibrations. Thus, for a man's voice the surfaces must be under a far greater pressure than for the movements of insects; still the range of useful effect is very great, as the boxes which I have specially arranged for a man's voice are still sensitive to the tick of a watch.

In all cases it should be so arranged that a perfect undulatory current is obtained from the sonorous vibrations of a certain range. Thus, when speaking to a microphone transmitter of human speech, a galvanometer should be placed in the circuit, and, while speaking, the needle should not be deflected, as the waves of + and − electricity are equal, and are too rapid to disturb the needle, which can only indicate a general weakening or strengthening of the current. If the pressure on the materials is not sufficient, we shall have a constant succession of interruptions of contact, and the galvonometer-needle will indicate the fact. If the pressure on the materials is gradually increased, the tones will be loud but wanting in distinctness, the galvanometer indicating interruptions; as the pressure is still increased, the tone becomes clearer, and the galvanometer will be stationary when a maximum of loudness and clearness is attained. If the pressure be further increased, the sounds become weaker, though very clear, and, as the pressure is still further augmented, the sounds die out (as if the speaker was talking and walking away at the same time) until a point is arrived at where there is complete silence.

When the microphone is fixed to a resonant board the lower contact should be fixed to this board, so that the sonorous vibrations act directly on it. The upper contact, where the pressure is applied, should be as free as possible from the influence of the vibrations, except those directly transmitted to it by the surfaces underneath; it (the upper surface) should have its inertia supplemented by that of a balanced weight. This inertia I find necessary to keep the contact unbroken by powerful vibrations. No spring can supply the required inertia, but an adjustable spring may be used to ensure that the comparatively heavy lever shall duly press on the contacts.

The superposed surfaces in contact may be screwed down by an insulated screw passing through them all, thus doing away with the lever and spring; but this arrangement is far more difficult to adjust, and the expansion by heat of the screw causes a varying pressure. It is exceedingly simple, however, easily made, and illustrates the theoretical conditions better than the balanced lever I have adopted in practice. In order to study the theoretical considerations, and that with the most simple form of microphone, freed from all surrounding mechanisms, let us take a flat piece of charcoal two millims. thick and one centim. square, and, after making electrical contact by means of a copper wire on the lower surface, glue that to a small resonant board, or, better for the purpose of observation, to a block or cube of wood ten centims. square. Upon this superpose one or more similar blocks, the upper surface in communication with a wire, the lower resting *flat*, or as nearly so as possible, on the lower block.

The required pressure is put on the upper block, and while in this state the two may be fastened together with glue at the sides, or, better, by an insulated screw. The pressure can then be removed, as the screw or glue equally preserves the force. Let the lower piece be called A and the upper B: when we put this block or board under sonorous vibrations, we cannot suppose an undulatory movement of the actual wave-length in such a mass, that is a length comparable with the real wave-length of the sonorous wave which may be several feet. Now we cannot suppose a wave of any length without admitting that the force must be transmitted from molecule to molecule throughout the entire length: thus any portion of a wave, of which this block represents a fraction, must be in molecular activity. The lower portion of the charcoal A, being part of the block itself, has this molecular action throughout, transmitting it also to the upper block. How is it that the molecular action at the surfaces A and B should so vary the conductivity or electrical resistance as to throw it into waves in the exact form of the sonorous vibrations? It cannot be because it throws up the upper portion, making an intermittent current, because the upper portion is fastened to the lower, and the galvanometer does not indicate any interruption of current whatever. It cannot be because the molecules arrange themselves in stratified lines, becoming more or less conductive, as then surfaces would not be required—that is, we should not require discontinuity between the blocks A and B; nor would the upper surface be thrown up if the pressure be removed, as sand is on a vibrating glass. The throwing up of this upper piece B when pressure is removed proves that a blow, pressure, or upheaval of the lower portion takes place—that this takes place there cannot be any doubt, as the surface, considered alone (having no depth), could not bodily quit its mass. In fact, there must have been a movement to a certain depth; and I am inclined to believe, from numerous experiments, that the whole block increases and diminishes in size at all points, in the centre as well as the surface, exactly in accordance with the form of the sonorous wave. Confining our attention, however, to the points A and B, how can this increased molecular size or form produce a change in the electrical waves? This may happen in two ways: *first*, by increased pressure on the upper surface, due to its enlargement; or, *second*, the molecules themselves, finding a certain resistance opposed to their upward movement, spread themselves, making innumerable fresh points of contact. Thus, an undulatory current would appear to be produced by infinite change in the number of fresh contacts. I am inclined to believe

[1] By Prof. Hughes. Communicated to the Physical Society, June 8, 1878.

that both actions occur, but the latter seems to me the true explanation; for if the first was alone true, we should have a far greater effect from metal powder, carbon, or some elastic conductor as metallised silk, than from gold or other hard unoxidisable matter; but as the best results as regards the human voice were obtained from two surfaces of solid gold, I am inclined to view with more favour the idea that an infinite change of fresh contacts brought into play by the molecular pressure affords the true explanation. It has the advantage of being supported by the numerous forms of microphone I have constructed, in all of which I can fully trace this effect.

I have been very much struck by the great mechanical force exerted by this uprising of the molecules under sonorous vibrations. With vibrations from a musical box two feet in length I found that one ounce of lead was not sufficient on a surface of contact one centim. square to maintain constant contact; and it was only by removing the musical box to a distance of several feet that I was enabled to preserve continuity of current with a moderate pressure. I have spoken to forty microphones at once, and they all seemed to respond with equal force. Of course there must be a loss of energy in the conversion of molecular vibrations into electrical waves, but it is so small that I have never been able to measure it with the simple appliances at my disposal. I have examined every portion of my room—wood, stone, metal, in fact all parts, and even a piece of India-rubber—all were in molecular movement whenever I spoke. As yet I have found no such insulator for sound as gutta-percha is for electricity. Caoutchouc seems the best; but I have never been able, by the use of any amount at my disposal, to prevent the microphone reporting all it heard.

The question of insulation has now become one of necessity, as the microphone has opened to us a world of sounds, of the existence of which we were unaware. If we can insulate the instrument so as to direct its powers on any single object, as at present I am able to do on a moving fly, it will be possible to investigate that object undisturbed by the pandemonium of sounds which at present the microphone reveals where we thought complete silence prevailed.

I have recently made the following curious observation:—A microphone on a resonant board is placed in a battery-circuit together with two telephones. When one of these is placed on the resonant board a continuous sound will emanate from the other. The sound is started by the vibration which is imparted to the board when the telephone is placed on it; this impulse, passing through the microphone, sets both telephone-discs in motion; and the instrument on the board, reacting through the microphone, causes a continuous sound to be produced, which is permanent so long as the independent current of electricity is maintained through the microphone. It follows that the question of providing a *relay* for the human voice in telephony is thus solved.

The transmission of sound through the microphone is perfectly duplex, for if two correspondents use microphones as transmitters and telephones as receivers, each can hear the other, but his own speech is inaudible; and if each sing a different note no chord is heard. The experiments on the deaf have proved that they can be made to hear the tick of a watch, but not, as yet, human speech distinctly; and my results in this direction point to the conclusion that we only hear ourselves speak through the bones and not through the ears.

However simple the microphone may appear at first glance, it has taken me many months of unremitting labour and study to bring to its present state through the numerous forms each suitable for a special object. The field of usefulness for it widens every day. Sir Henry Thompson has succeeded in applying it to surgical operations of great delicacy, and by its means splinters, bullets, in fact all foreign matter, can be at once detected. Dr. Richardson and myself have been experimenting in lung- and heart-diseases, and although the application by Sir H. Thompson is more successful, I do not doubt but that we shall ultimately succeed. There is also hope that deafness may be relieved, for telephony articulation has become perfect and the loudness increased. Duplex and multiplex telegraphy will profit by its use, and there is hardly a science where vibrations have any direct or indirect relation which will not be benefited. And I feel happy in being able to present this paper on the results obtained by a purely physical action to such an appropriate and appreciative body as the Physical Society.

In conclusion, allow me to state that throughout the whole of my investigations I have used Prof. Bell's wonderfully sensitive telephone instrument as a receiver, and that it is thanks to the discovery of so admirable an appliance, that I have been enabled to commence and follow up my researches in microphony.

LABORATORY NOTES

DURING the daily routine of life in a laboratory many observations are made of an isolated character, perhaps having no direct bearing on the subject in hand, but which, nevertheless, may be eminently suggestive to other minds. The record of such observations are often lost; they are not communicated unless they find a place in a larger research, and they go to form the capital which every worker is accumulating till his death, much of which, unfortunately, perishes with him. I therefore cordially approve of the suggestion of the Editor that workers in the various departments of experimental science should occasionally write a few notes containing a brief account of any observations recently made, and I shall be glad to contribute my quota.

1. *Carl Zeiss' New Oil Immersion Lens.*—This is a $\frac{1}{8}$th-objective, on the immersion system, in which the fluid used is oil of cedar-wood. For amount of light, clearness of definition, resolving power, and flatness of field, it is superior to any lens I have worked with. For use in histological observation, it does not require any special arrangement of light. In examining such objects as blood-corpuscles or salivary cells with very high powers it is of great advantage to be able to use cover-glasses of ordinary thickness, and to have a serviceably-working distance. This is secured by Zeiss' lens. I have found that, with ordinary Nos. 6 and 7 Hartnack-objectives, more light is obtained by using them as immersion-lenses with a drop of equal parts of oil of cedar-wood and olive oil. The method of using fluids of high refractive index, on the immersion principle, seems to me likely to lead to valuable results. With oblique light, cutting off light from the mirror, the performance of Zeiss' lens is remarkably good.

2. *The Phonograph as a Transmitter.*—By placing Hughes' microphone on the disc of the phonograph the latter will transmit the sounds recorded on the tinfoil to a telephone at a distance. Thus we have a combination of microphone, phonograph, and telephone, which promises to be of use. It is very suggestive to hear the phonograph speaking in one room and to know that some one else in another room, or at a long distance off, is also hearing a repetition of the sound. I have no doubt that arrangements might be made by which the sound might be reproduced in a dozen different places at once.

3. *The Working of the Phonograph.*—After a good deal of experience I have come to the conclusion that a thin and slightly elastic membrane is the most suitable for loudness, whilst a rigid non-elastic membrane is most adapted for distinctness. From a consideration of the histological structure of the drum of the ear this is what one would expect. After the impressions have been made on the tinfoil, distinct speech, in a feeble voice, of most peculiar quality, like what one would imagine to be the tones of the fairies of old, can be heard from one of Marey's tambours, by bringing the point of the lever on the surface of the phonographic cylinder. With this method there is almost no friction, and consequently the marks on the tin-foil are not quickly rubbed out. By connecting a tube with the tambour and carrying it from the tambour to the ear, sounds may be heard, even as speech, after the marks have been so erased from the tinfoil as to be scarcely perceptible to the eye. Thus the tambour, when so used, may be said to be a microphone.

4. *The Microphone.*—I have tried many experiments with the ingenious arrangement of Mr. Hughes, and have been much impressed with its extreme sensitiveness. It may be used to make and break at pleasure the primary coil of the induction machine. When fixed to the box of a monochord the slightest touch of the wire with a camel-hair pencil sounds loudly in the distant telephone. When placed on the sounding-board of a piano, I have heard distinctly a complicated piece of music eighty yards away; when attached to the throat by an india-rubber band, the faintest trill or whisper is audible; and it transmits the muscular sound from a powerful biceps.

5. *A Lecture Experiment.*—Place the heart of a frog on the electrodes of Du Bois-Reymond in connection with a sensitive reflecting galvanometer. The rhythm of the pulsations may then be observed by the swinging to and fro of the spot of light on a transparent screen. This has often been observed by

physiologists, but, considered as a lecture experiment, it is very instructive.

6. *The Sensibility of the Telephone to Feeble Currents.*—As an example of this, I may instance the following experiment:—The gastrocnemius muscle of a frog was placed on the non-polarisable electrodes of Dubois Reymond, so that the transverse section touched the one electrode, and the longitudinal surface the other; the current thus obtained, when sent through a reflecting galvanometer, was sufficient to drive the spot of light from end to end of the scale, placed about three feet in front of the galvanometer; the galvanometer was then disconnected, and a telephone placed in circuit; it was then found that on making and breaking the current, a faint but sharp click of the telephone plate was heard. No click could be heard when the muscle was removed and the two electrodes were connected with a bit of moist blotting paper. The muscle current was therefore sufficient to act on the telephone. The click was stronger when the muscle was placed in contact with two platinum terminals, and when a small carbon microphone was also placed in circuit. I then tried to ascertain whether any effect on the click could be produced by throwing the muscle into a state of tetanus, and I found that in these circumstances no click could be heard at all. In other words, during the state of muscular contraction the muscle current was so diminished (the *negative variation* so called) as to be unable so to affect the telephone as to produce audible sounds. The telephone thus was used instead of the galvanometer in a physiological experiment.

JOHN G. MCKENDRICK

Physiological Laboratory,
University of Glasgow, June 17

VOLCANIC PHENOMENA AND EARTHQUAKES DURING 1877

ALTHOUGH the most important results from the statistics of volcanic phenomena and earthquakes are obtained only if the observations and records spread over a period of many years, yet a number of interesting facts are revealed even in the compilation of the phenomena which occur during a single year. Prof. C. W. C. Fuchs is most indefatigable in these compilations, and he has recently published his statistical account of eruptions and earthquakes for the year 1877. From this we note the following details:—

During 1877 five important eruptions of different volcanoes took place. The eruption of the South American volcano Cotopaxi which lasted from June 25 to 28, was of a most characteristic nature for this mountain. According to the phenomena by which it was accompanied, it must be designated as an eruption of ashes and mud. Although Alexander von Humboldt's view, that the South American volcanoes do not produce lava, has been refuted long ago (Cotopaxi sent forth a copious stream of lava in 1853) yet the most frequent eruptions from this mountain are those of ashes only, without a flow of lava. Streams of mud are often combined with eruptions of this kind, and have different causes; in 1877 they particularly devastated the valleys of Chila and of Tumbaco, and in the former many hundreds of lives were lost through them. The ashes which the volcanos ejected so filled the air that complete darkness reigned everywhere, and the dust was so fine that it entered even into the interior of houses, although the doors and windows were shut.

The most violent eruption of 1877 occurred upon the island of Hawaii. Twice interrupted, the lava forced its way to the surface in three different places, and thus furnished the most undeniable proof that one and the same bed or hearth of lava, may produce eruptions in any of the numerous craters of Hawaii, according to time and circumstances. The first part of the eruption occurred on February 14 from a little side crater close to the summit of Mauna Loa; its duration was six hours, and the height of the column of smoke, which assumed the shape of an Italian pine-tree, was estimated at 5,000 metres. The second part occurred on February 24, in the Bay of Kalukeakua, well known as the place in which Cook, the great discoverer of the Sandwich Islands, was assassinated. This eruption was submarine, and lasted two days; its seat was in the middle of the bay, which is surrounded by numerous prehistoric records of its volcanic nature. On May 4 the lava found its usual way to the surface through the lava lake of Kilauea, which has solidified for some time. Here the wonderful phenomenon of high jets of lava occurred, a phenomenon which is peculiar to this spot only. During a period of six hours, now here, now there, vast jets o liquid lava rose from the ground, and their number was so great that at one time more than fifty simultaneous ones were counted, some reaching an altitude of thirty metres.

The third eruption was that of the small Japanese island-volcano, Ooshima, and lasted from January 4 to February 6 or 7. Violent subterranean noise and disastrous earthquakes accompanied the volcanic phenomena, particularly on January 20 and on February 4 and 5.

On June 11 an eruption occurred in a volcanic district almost unknown hitherto, viz., near the Colorado River in Southern California, at some sixty miles' distance from Fort Yuma. The last eruption was a submarine one, and happened on June 15, near the Peruvian coast.

The number of earthquakes during 1877, of which Prof. Fuchs was able to obtain reliable accounts, amounts to 109, and he remarks that this is very nearly the average number per year, if compared to his annual compilations, which now extend over a period of thirteen years. They were distributed over the seasons of the year as follows:—

December, January, February ...	33 earthquakes.
March, April, May	31 ,,
June, July, August	11 ,,
September, October, November ...	34 ,,

On fifteen days several earthquakes occurred simultaneously in different places. Certain districts, such as Peru, Bolivia, Tokiô (Japan), the Island of Ooshima, Hawaii, &c., were visited by real earthquake periods, consisting of a large number of more or less violent shocks and detonations, while in others several earthquakes, separated by long periods of tranquillity, were observed. Among the latter we note—

Judenburg (Styria): January 4, December 27 and 28.
Western Odenwald: January 2 and 10.
Wald (Styria): January 12, September 5.
Rattenberg (Tyrol): April 8, October 11.
Bad Tüffer (Styria): April 4, 7, 24, 25, September 12.
Callao: April 22, May 14, October 9.
Western Switzerland: May 2, October 8, November 30.
Lisbon: November 1 and 4, December 22.

The earthquakes in Switzerland spread over a very considerable area. The first shocks on May 2 began near the Lake of Zürich and proceeded in three directions, viz., as far as Glarus and St. Gallen in the east, Mühlhausen in Alsace in the west, and the Black Forest in the north. They were followed by others more violent, and even more widely spread, on October 8. These were felt most severely at Geneva, where many chimneys were thrown to the ground; but they were distinctly noticed in the whole canton of Geneva, as well as in the Vaud, the Valais, Neufchatel, Berne, Freiburg, and Basel, and also in the French departments of Drôme, Isère, Rhone, Savois, Aix, Jura, Doubs, and even at Mühlhausen in Alsace. The extent of this earthquake towards the west was therefore a far more considerable one than towards the east, where the Alps seem to have hindered its progress; only in the broad Rhone Valley it was felt as far as Sitten. This is all the more remarkable since the Jura Mountains seem to have been without influence regarding its progress in the west. The greatest breadth of the area where the phenomenon was noticed, *i.e.* from Lyons to Sitten, measures some 200 kilometres, while its greatest length, *i.e.* from Valence to Mühlhausen, is 337 kilometres.

Another earthquake of large extension was the one felt on April 4 in the Eastern Alps; it was observed from Lower Styria as far as the junction of the Save with the Danube.

The most violent earthquake of all was the one which occurred on the South American coast on May 9, and in its whole course, as well as with regard to the minor phenomena which accompanied it, it can be compared only to the earthquake which occurred in the same region on August 13, 1868. We gave at the time details concerning this disastrous occurrence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

At the distribution of prizes at the Yorkshire College last Friday the reports were, on the whole, satisfactory, though the institution has yet much to struggle against. Its great want is want of funds, for, though it has had many generous givers, it takes a great deal of money to start an institution of such magnitude. The college, however, seems extending its influence, and we think there can be no doubt of its ultimate complete success. The Marquis of Ripon spoke cheerfully both of the present and future of the college, and gave the students some excellent advice as to the aims they should set before them in pursuing their studies.

On the same day a similar ceremony was held at Owens College, Manchester, when much surprise was expressed that the Yorkshire College should oppose the Manchester University scheme. There need be no surprise at this, though we think that, if the two institutions thought of nothing but the educational welfare of the north of England, they would not find it so difficult to see eye to eye.

The Kirgis tribes of Siberia have contributed about 3,000*l*. to the university of Kasan, to serve as a fund for stipends for Kirgis students.

The continued existence of duels in the German universities is a sad blot on modern Teutonic civilisation. Within the past few weeks two deaths from pistol duels have occurred at the universities of Erlangen and Pest.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, Ergänzung Band viii. Stück 4.—In an inaugural dissertation, with which this number opens, Dr. Less investigates the heat conductivity of some seventeen varieties of stone, and several kinds of wood, his method being a refinement on that of Hopkins, with whose results (for stone) his own generally agree, only the numbers obtained for different varieties of one rock vary much more. In general, density and compactness favour the passage of heat, though the effect evidently does not depend on this alone. Stones of crystalline texture conduct better than those mechanically mixed, and fine-grained better than coarse-grained stones. In his table, marble from the Pyrenees is put at the top, its conductivity being reckoned 1,000; then follow Saxon granite (804), Carraran marble (769), &c., down to common clay (275). Tyndall's observation of a difference in conduction in two directions (with and at right angles to the fibres) in wood is confirmed, but the differences are found considerably less. The ratios of the galvanometer deflections are much greater in the better-conducting than in the worse-conducting woods, making it very probable that these deflections are proportional, not to the conductivities themselves, but to a somewhat higher power of them.—In two papers dealing with magnetic induction and Clausius and Weber's fundamental laws of electro-dynamics, M. Lorberg, by a development of the theory of two experiments, arrives at results throwing doubt on Clausius' law, and endeavours to show that Weber's is the only possible one.—M. Sadebeck contributes a lengthy paper on the crystallisation of markasite, and its regular growths with iron pyrites; and M. Schönn describes the absorption of light by water, petroleum, ammonia, alcohol, and glycerine.

Bulletin de l'Académie Royale de Belgique, No. 3, 1878.—In this number MM. Navez further describe their new system of telephony, by which they claim to speak at distances which are beyond the power of Bell's instruments, with an intensity equal to that of persons speaking face to face. The sender is a modified form of Edison's. A steel bar, supported in a tube, rests vertically on some rundles of retort carbon on the plate, which is copper covered with silver, and to which the sound of the voice passes through a tube of vulcanised caoutchouc attached below; bar and plate are of course in circuit, as also an induction coil. The plate is pinched between hardened caoutchouc and mahogany, which latter supports, on rundles of caoutchouc, a zinc disc with central tube for the steel bar.—Reviewing the geographical distribution of Balænopteræ, M. van Beneden shows that we cannot consider any of the four species of Balænopteræ and the one Megaptera, frequenting the North Atlantic, as proper to Europe. They all, or nearly all, visit the east coasts of North America, as well as the west coasts of Europe, and proceed, both eastwards and westwards, into the Pacific. The North Atlantic species have all representatives in the North Pacific, and *Rachianectes* alone has no representative beyond the Pacific.—Among other zoological papers M. Fraipont furnishes the second and third portions of his researches on the Acetinians of the Ostend coast (three of the forms described are new to science), and M. Longchamps makes additions to the synopsis of the Cordulinæ.—In an interesting memoir reported on by MM. van der Mensbrugghe and Folie, M. Lagrange concludes that a deformable mass, subjected to the attraction of another deformable mass, in rotation takes a motion of rotation in the same direction, which result he proposes to apply to explain the origin and establishment of astronomical movements.

Bulletin of the United States Geological and Geographical Survey of the Territories, vol. iv. No. 2, Washington, May, 1878, contains the following articles:—The geographical distribution of the mammalia considered in relation to the principal ontological regions of the earth and the laws that govern the distribution of animal life, by J. A. Allen.—Descriptions of new extinct vertebrata from the upper tertiary and Dakota formations, by E. D. Cope (describes a large number of new reptile, bird, and mammalian forms).—Notes on a collection of fishes from the Rio Grande at Brownesville, Texas, and a catalogue of the freshwater fishes of North America, by Dr. D. Jordan.—Description of a fossil passerine bird from the insect-bearing shales of Colorado, by J. A. Allen, with a plate.—The coleoptera of the Alpine regions of the Rocky Mountains, by Dr. J. L. Le Conte.—On the orthoptera of Dakota and Montana, by Prof. Cy. Thomas.—On the hemiptera of the same, by P. R. Uhler.—On the lepidoptera of Montana, by W. H. Edwards.—On some insects of unusual interest from the tertiary rocks of Colorado and Wyoming, by S. H. Scudder.

Schriften der physikalisch ökonomischen Gesellschaft zu Königsberg (1876, Nos. 1 and 2, and 1877, No. 1).—These parts, besides a large number of smaller papers and notes, contain the following more important treatises:—On the flora of the great Werder, near Marienberg, by I. Preuschoff.—Report on the recent excavations at Tengen, near Brandenburg (Natangen), by R. Klebs.—On the mechanical principle of equal temperatures in the bodies of the higher animals, by Dr. A. Adamkiewicz.—On some remains of extinct buffalo species from the province of Prussia, by Dr. Jentzsch.—On the decrease in the quantity of water in the rivers of cultivated countries, by Dr. Krosta.—On archæological museums, by O. Tischler.—On some physical relations between the human and animal organism and anorganic nature, by Prof. Grünhagen.—On the latest improvements in the photographic pigment printing process, by Dr. Benecke.—On some antiquities from Claussen, by Dr. Jentzsch.—On the latest discoveries in the diluvial fauna of East Prussia, by the same.—On the strata containing amber in the so-called Samland, by Herr Marcinowski.—On the formation of amber, by Dr. Jentzsch.—On the geognostical investigation of the province of Prussia during the year 1876, by the same.—On the *Macro-lepidoptera* of the province of Prussia, by Rob. Grentzenberg.—On the distribution of rain over the year 1876, by Dr. Schiefferdecker.—On truffles, by Dr. Caspary.—On the great Indian census of 1872, by Dr. Wagner.—Speech in memory of the late Dr. K. E. von Baer, by Prof. Zaddach.—On a naval chart from the fourteenth century, by Dr. Jentzsch.—Full reports of the meetings of the Prussian Botanical Society of Königsberg.—Craniological researches, by Dr. Kupffer.—On a map of the world dating from the year 1452, by Dr. Jentzsch.—On the retina purple, by Dr. von Wittich.—New researches on the habits of ants, Dr. Gwalina.

SOCIETIES AND ACADEMIES

London

Royal Society, May 16.—"On the Variations of the Diurnal Range of the Magnetic Declination as Recorded at the Prague Observatory," by Balfour Stewart, LL.D., F.R.S., Professor of Natural Philosophy at Owens College, Manchester.

The Prague observations began in July, 1839, and have been continued until the present date. They have been dealt with in the same way as those of Kew and Trevandrum. In the first place a set of nine-monthly values of declination range has been obtained corresponding to similar nine-monthly values of spotted solar area. When these are graphically plotted it is found that a number of points in the sun-spot curves may be fairly identified as corresponding to certain points in the declination-range curve, but that the latter invariably lag behind the former in time.

This will be seen from the following table, in which the epochs of maximum and minimum sun-spots are compared with those of declination-range:—

Solar min., June 15, 1843	Prague, dec.-range, min., Feb. 28, 1844.
Solar max., Dec. 15, 1847	Prague, dec.-range, max., March 31, 1848.
Solar min., Sept. 15, 1855	Prague, dec.-range, min., March 31, 1856. Trevandrum, dec.-range, min., Feb. 15, 1856.
Solar max., Nov. 15, 1859	Kew, dec.-range, max., April 15, 1860. Trevandrum, dec.-range, max., May 15, 1860.
Solar min., March 15, 1867	Kew, dec.-range, min., August 15, 1867.

In the next place variations are found in the declination range at Prague which appear to depend on planetary configurations, and which are similar in character to those found at Kew and Trevandrum.

An inspection of the sun-spot records reveals the fact that at times of maximum spot frequency, not only are there most spots on the sun, but that the sun-spot inequalities or oscillations (however produced) are at such times much more prominent than during times of minimum sun-spot frequency. Now, if it be true that these spot periods are due in a great measure, if not entirely, to planetary configurations, we might expect that (possibly from an increase in the susceptibility of the sun) the planetary periods should at times of maximum sun-spots be found to be greater than their average value.

This is found as a matter of fact to be the case, as will be seen from the following table, comparing together observed sun-spot planetary inequalities for periods of maximum sun-spots with the corresponding mean inequalities:—

				Period of Mercury. Observed.	Mean.
Between	0	and	30	− 2·31	− 3·95
,,	30	,,	60	− 20·85	− 10·63
,,	60	,,	90	− 33·07	− 12·10
,,	90	,,	120	− 40·37	− 12·33
,,	120	,,	150	− 37·50	− 11·96
,,	150	,,	180	− 21·30	− 10·13
,,	180	,,	210	− 2·04	− 5·83
,,	210	,,	240	+ 18·29	+ 1·54
,,	240	,,	270	+ 37·09	+ 6·99
,,	270	,,	300	+ 47·73	+ 10·00
,,	300	,,	330	+ 43·55	+ 8·91
,,	330	,,	360	+ 22·22	+ 3·63

				Mercury and Jupiter together. Observed.	Mean.
Between	0	and	30	− 5·76	− 3·22
,,	30	,,	60	− 18·95	− 7·56
,,	60	,,	90	− 33·26	− 11·72
,,	90	,,	120	− 43·66	− 13·11
,,	120	,,	150	− 37·91	− 10·91
,,	150	,,	180	− 27·22	− 8·71
,,	180	,,	210	− 11·24	− 4·84
,,	210	,,	240	+ 10·78	+ 0·73
,,	240	,,	270	+ 27·76	+ 5·45
,,	270	,,	300	+ 37·35	+ 8·33
,,	300	,,	330	+ 35·33	+ 7·29
,,	330	,,	360	+ 16·62	+ 2·41

If we now turn to declination-ranges we shall find that there are greater oscillations or sub-periods in the value of these ranges during times of maximum than during times of minimum sun-spots. But on the other hand the increased value of such oscillations is by no means so striking as in the case of sun-spots. Mr. Broun has already made the remark that while there is an increase in the whole declination-range during times of maximum sun-spots, yet this increase is not so marked as in the case of the spots themselves, inasmuch as we have a considerable declination-range when there are no spots on the sun. From what has now been said it would seem that a similar remark applies to the oscillations or sub-periods of declination-range, which, while increasing from times of minimum to times of maximum sun-spots, do not yet increase so strikingly as the oscillations or sub-periods of the spots themselves.

If we now treat the inequalities of magnetic declination that appear to depend on the two most available planetary configurations in the manner in which we have just treated sun-spot inequalities, we might expect the observed magnetic inequalities corresponding to times of maximum sun-spots to be greater than the mean inequalities, but not to the same extent as in the case of sun-spots.

That this is the case will be seen from the following table, in which observed declination-range, planetary inequalities for periods of maximum sun-spots are compared with the corresponding mean inequalities:—

				Period of Mercury. Observed.	Mean.
Between	0	and	30	+ 11·48	+ 10·42
,,	30	,,	60	+ 3·62	+ 7·25
,,	60	,,	90	− 3·50	− 2·25
,,	90	,,	120	− 6·91	− 3·25
,,	120	,,	150	− 9·13	− 8·16
,,	150	,,	180	− 12·37	− 11·67
,,	180	,,	210	− 13·72	− 12·12
,,	210	,,	240	− 10·44	− 8·68
,,	240	,,	270	− 2·45	− 2·62
,,	270	,,	300	+ 7·73	+ 4·10
,,	300	,,	330	+ 15·14	+ 9·26
,,	330	,,	360	+ 16·20	+ 11·27

				Mercury and Jupiter together. Observed.	Mean.
Between	0	and	30	+ 11·87	+ 11·61
,,	30	,,	60	+ 2·56	+ 8·07
,,	60	,,	90	− 4·26	+ 2·75
,,	90	,,	120	− 8·72	− 2·45
,,	120	,,	150	− 13·85	− 7·93
,,	150	,,	180	− 16·24	− 11·97
,,	180	,,	210	− 13·44	− 11·80
,,	210	,,	240	− 8·32	− 8·71
,,	240	,,	270	+ 0·51	− 3·11
,,	270	,,	300	+ 11·39	+ 3·44
,,	300	,,	330	+ 16·91	+ 8·74
,,	330	,,	360	+ 17·06	+ 11·89

It thus appears that in the case of the magnetic declination periods there is (as in those of sun-spots) an exaltation of the observed over the mean values during times of maximum sun-spot frequency, but this exaltation is not so marked as in the case of sun-spots. Now, without pretending to know in what way the sun influences the magnetism of the earth, we may imagine that the increased values not only of the average declination-range but also of the sub-periods of these during times of maximum sun-spots may be due to one of two causes, or to both of these together. Thus we may imagine that the sun has an increased magnetic influence during such periods, or we may imagine that there is an increase in the magnetic susceptibility of the earth; or, finally, we may imagine that both of these causes operate together. The author cannot help thinking that we have some evidence of an increase of the magnetic susceptibility of the earth on such occasions derived from two facts discovered by Mr. Broun. The one is that the magnetic influence of the moon on the earth shows traces of following the solar period, this influence being greater during times of maximum than during times of minimum sun-spots. The other is that at Trevandrum the lunar magnetic influence, without changing its type, exhibits an increase of value when the sun is above the horizon at that place, as if on such occasions there were an increase of susceptibility to the lunar influence. These, however, are points which can only be determined by a further discussion of observations.

Geological Society, May 22.—Henry Clifton Sorby, F.R.S., president, in the chair.—John Collins was elected a Fellow of the Society.—The following communications were read:—On the serpentine and associated igneous rocks of the Ayrshire coast, by Prof. T. G. Bonney, M.A.—In a paper published in the *Quarterly Journal of the Geological Society*, vol. xxii. p. 513, Mr. J. Geikie states that the rocks of this district are of sedimentary origin, a felspar-porphyry being the "*maximum* stage of metamorphosis exhibited by the felspathic rocks," and the diorite, hypersthenite, and serpentine being all the result of metamorphism of bedded rocks. This view is also asserted in the catalogue of the rocks collected by the Geological Survey of Scotland. The author had seen specimens of rocks from this district which so closely resembled some from the Lizard, that he visited the Ayrshire coast in the summer of 1877. The author is of opinion that the principal conclusions of the paper referred to above are not warranted by either stratigraphical or lithological evidence. He considers it probable that the "felspar-porphyry," like so much of that in Scotland, is of old red sandstone age, and that the serpentine is of later date, but palæozoic.—On the metamorphic and overlying rocks in the neighbourhood of Loch Maree, Ross-shire, by Henry Hicks, M.D., F.G.S. The rocks in the neighbourhood of Loch Maree have been described by various authors, but chiefly and most recently in papers communicated to the Geological Society by Prof. Nicol, of Aberdeen, and by Sir R. Murchison and Prof. Geikie, of Edinburgh. In the present communication the author endeavours to show, from results obtained by him recently by a careful examination of a section extending from Loch Maree to Ben Fyn, near Auchnasheen, that the interpretations previously given are in some important points incorrect, and that this has been to a great extent the cause of such very diverse opinions.—On the triassic rocks of Normandy and their environments, by W. A. E. Ussher, Esq., F.G.S.—On foyaite, an elæolitic syenite occurring in Portugal, by C. P. Sheibner, Ph.D., F.G.S. Communicated by Prof. T. M'Kenny Hughes, M.A., F.G.S.

Zoological Society, June 4.—Prof. Flower, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited a young specimen of Temminck's Manis (*Manis temmincki*), and read a note describing habits of this animal in captivity by Mr. F. Holmwood, Assistant Political Agent at Zanzibar.—Mr. Sclater also called attention to the extraordinary mimicry of the true rectrices by the elongated upper tail coverts in *Ciconia maguari* and *C. episcopus*, as observable in the living examples of these birds in the Society's Gardens.—Mr. Edward R. Alston exhibited, on behalf of Dr. Elliott Coues, two specimens of *Synaptomys cooperi*. To this species—the type of *Synaptomys*, proposed in 1867 by Prof. Baird as a sub-genus of *Myodes*—full generic rank was accorded by Dr. Coues in 1874. The present specimens were, so far as was known, the first typical specimens sent to Europe.—Prof. Huxley, F.R.S., read a memoir on the cray-fishes, in which he gave a review of the various generic divisions of this group of podophthalmous crustacea, and pointed out how remarkably these divisions corresponded with their geographical distribution.—Prof. W. H. Flower, F.R.S., exhibited the skull of a two-horned rhinoceros from Tipperah, and read a note on the peculiarities of its structure.—A communication was read from Messrs. Godman, Salvin, and Druce, containing a catalogue of the lepidoptera collected by Mr. S. N. Walter in the Island of Billiton.—Messrs. Godman and Salvin also read a list of the butterflies collected in Eastern New Guinea and some neighbouring islands by Dr. Comrie, during the voyage of H.M.S. *Basilisk*.—Mr. A. G. Butler, F.Z.S., read a paper containing the description of a new species of the orthopterous genus *Phylloptera*, from Madagascar, which he proposed to name *Phylloptera segonoides*.—Messrs. Sclater and Salvin read a report on the collection of birds made during the voyage of H.M.S. *Challenger*. The present communication, forming the eleventh of the series, contained a description of the Steganopodes and of the Impennes. Of the first group the collection contained thirty-three specimens belonging to eight species; of the second, thirty seven specimens belonging to six species.—Prof. E. Ray Lankester read a paper in which he gave an account of the structure of the hearts of *Ceratodus*, *Protopterus*, and *Chimæra*, with an account of certain undescribed pocket-valves in the conus arteriosus of *Ceratodus* and of *Protopterus*.

Institution of Civil Engineers, May 28.—Mr. John Frederic Bateman, F.R.S., president, in the chair.—The discussion on Mr. T. C. Clarke's paper on the design of iron railway bridges of very large spans, was continued throughout the evening.

ROME

R. Accademia dei Lincei, April 7, 1878.—The following among other papers were read:—Human skeleton in a cavern of the Arena Candida, near Finalmarina, by M. de Sanctis.—Palæontological notes on a large fossil humerus of a bear and other bones of a stag, from a cave near Poggio Mojano, by M. Ponzi.—New researches on Fourier's series, by M. Ascoli.—On carbotialdina and some other sulphurised compounds, by M. Guareschi.—On some derivatives of tetrachlorated ethers, by M. Paterno.—On new derivatives of santonines, by M. Valenti.—On secular variations of the magnetic declination at Rome, by M. Kella.—Map of the planet Mars, by M. Schiaparelli.—On Hofmannite, by M. Bechi.

PARIS

Academy of Sciences, June 10.—M. Fizeau in the chair.—The following among other papers were read:—On the results furnished by chronometers having springs with theoretical terminal curves, at the prize competition of 1877, at Neuchâtel Observatory, by M. Phillips. Of the 220 chronometers sent in 186 had springs with theoretical curves. M. Granjean's occupied the first place for their remarkable accuracy.—On the gemmiparous and fissiparous reproduction of Noctilucæ (*Noctiluca miliaris*, Suriray), by M. Robin. The processes are detailed, and several new facts communicated.—On the conservation of old types of ships, by Admiral Paris. The author's project is to reproduce figures of ancient ships from all parts of the world; he has written to the naval authorities in many countries to send drawings, with explanatory data. Some of his plates are exhibited in the Champ de Mars.—Functions of leaves in the phenomenon of gaseous exchanges between plants and the atmosphere; *rôle* of stomates in the functions of leaves, by M. Merget. His conclusion, from experiments, is thus stated:—In aërial and aquatic-aërial plants, oxygen, nitrogen, and carbonic acid are exchanged normally between the interior and the exterior atmosphere by way of the stomatic orifices. These exchanges may be produced by simple diffusion; they are promoted by all causes capable of producing a rupture of equilibrium between the two atmospheres, and in the double gaseous circulation which follows, the two movements of entrance and exit are performed with equal facility.—Observation of the transit of Mercury at Paita, by Admiral Serres. The conditions were highly favourable, and 600 daguerrotypes were obtained. Each officer made an independent report.—Researches on the subnitrate of bismuth, by M. Riche. The mechanism of the action of this substance in the system is controverted. It is important that the druggist should supply for it always the same product, and that the sub-nitrate be exclusively prepared with water slightly calcareous according to the formula of Codex. Every product should be rejected which contains less than 12 to 13 per cent. of nitric acid.—On the physiological *rôle* of hypophosphites, by MM. Paquetin and Soly. They are shown to be not reconstituents but diuretics.—On the colouring matter of wines, by M. Gautier. Each stock produces one or several special colouring matters, and the principles of these substances together form a family of similar but not identical substances of the aromatic series, having the *rôle* of acids, partly combined in the wines under the form of ferrous salt, and apparently resulting from oxidation of the corresponding tannins. He describes the colouring matter of two stocks.

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