THURSDAY, SEPTEMBER 6, 1877

NATURE AND CONSTITUTION OF MAN

A Philosophical Treatise on the Nature and Constitution of Man. By George Harris, LL.D., F.S.A. (London: George Bell and Sons, 1877.)

DR. HARRIS has long been known as one of those social scholars who combine with much modern learning a great deal of the learning of the ancients. He is essentially an antiquary in science, and he has obviously collected and brought under ready command a fine array of authorities of various schools of thought and of many centuries. In the two handsome volumes which now lie before us, Dr. Harris has collected a rich store of the historical work of which he is so fond, bearing on the history of man in relation to his life and his physical and mental constitution. The author tells us in the preface that the object of his work is "to afford a comprehensive and complete survey of the nature of man as regards his intelligent being; to exhibit the direct and immediate connexion of each department in his constitution, with its corresponding relation; and to demonstrate the uniform mechanism of the whole as one entire and consistent system."

In the first of these volumes we meet with a preliminary dissertation containing "certain collateral considerations and conclusions concerning the nature of man;" and touching on such details as "the origination and production of animated bodies," "the constitution of animated bodies," "man in relation to both substance and spirit," "essence of spiritual being and the nature of the soul," "operations of spiritual beings," and similar topics. A good way further on in this volume we reach the first "book," which treats on "the medial nature and constitution of man," and which, under the five heads of "sensation, emotion, appetite, passion, and affection," brings the volume to its close.

In the second volume we have first put before us, in "book the second" the subject of "the moral nature and constitution of man." This is discussed under three heads—"moral disposition and character," "the moral desires," "the conscience." Finally, in the same volume we have the third and last book treating on "the mental nature and constitution of man," and embracing under the different subdivisions "the intellectual faculties," "the faculty of understanding," "the faculty of reason," "the faculty of genius," "the memory," "the concurrent operation and reciprocal influence of the various medial, moral, and mental endowments and powers of the soul," and "mental discipline and cultivation."

We have given the outline of these volumes in the order in which they are set forth, because it affords the best account of the matter of the volumes. None but a steady reader will take the trouble to go through so many pages of two closely reasoning volumes on subjects abstruse and confessedly difficult, and we who have steadily gone through them may therefore venture to pilot others on the way.

As we lay down the volumes we find the difficulties of reviewing them very considerable. If we were dealing with the works of a less earnest man than George Harris we should have no difficulty in finding some faults in every page. If we did not understand, or did not think that we do understand what he means by all the toil he has expended on these two books, we might say that the toil was all labour lost, and that to the making of books there is no end. In a word there is scope in the volumes for the critic of all minds all intelligences and all sentiments. The scholar might question the history, the experimentalist the science, the *littérateur* the style, the metaphysician the metaphysic; and all, within common rules of criticism, might be severe and at the same time fair.

The truth as it seems to us is that Dr. Harris in the whole of his work has not really endeavoured to set forth any new and original idea of his own absolutely, while yet he has, at the same time, proceeded on an idea which is not destitute of originality. He has striven like a true antiquarian to focus in his own mind the learning of others old and new and best on the subjects upon which he is treating, and then he has tried to plant on his pages his own view as a compound of the complete study. The conception is erudite and laborious to a singular and almost painful labour. It is a work in character with the mental form of a man who has been engaged all his life in judicial pursuits (as by the way is the case with Dr. Harris), and while, therefore, it is free of all fancy, it gives no such indication of individual analysis as shall separate his idea of what he has read from his idea of any one person whom he has read. He tells us, in fact, that "during the progress of the work many hundreds of minds have been dissected by the author," but he does not tell us the further truth, because he is obviously unconscious of the fact, that he has tried to make one dissection out of the whole.

We have said that in the mode of constructing the chapters of these volumes there is an originality in dealing with the accumulated learning of previous authors. Another feature which is quite novel in literature is also introduced by the author. He has laid other living authors under contribution, and whether they agree with him or differ from him he has published their views as he received them, *totidem verbis*. In these cases he has submitted his text, in proof, to the writers whose views he solicited, and having obtained their opinions he has tacked them on to the text in notes. In this manner we have presented to us the views of a number of authorities on many of the most curious and important points in the natural histories of men and animals. Let us give one illustration.

In the chapter on the faculty of understanding in the second volume Dr. Harris discusses or rather considers the question whether inferior animals surpass the human animal in any particular faculty. He reasons that they do and adduces in proof of his opinion "the almost intuitive knowledge which certain animals seem to possess of the virtues of particular herbs, as also of other substances, earths and mineral waters, to which they resort, successfully, in cases of sickness or bodily injury. Their discernment in this respect," he adds, "is probably owing to the great acuteness and perfection of their sensorial organs, which also enable them to detect and avoid poisons."

So much for the opinion of the author himself on this

nice point. But he is not content to let the reader rest on one opinion. He courts the views of nine other authorities who, he thinks, may throw some light on the subject. In this way we get opinions on one point of science rendered by men who are writing purely from their own knowledge without being aware that any one else is adding a word on the topic under consideration, viz., whether inferior animals have any special faculty which man has not. The result is very curious.

Darwin, one of the authorities consulted, doubts the opinion altogether. He knows of no facts making it probable that animals perceive any qualities that are not perceived by us. He does not believe that any animal knows what herbs are poisonous, except through experience during former generations, by which an inherited association or instinct has been acquired against any particular herb. Quatrefages admits the view of the author to a certain extent, and in some cases he believes it to be necessary to admit the intervention of instinct, but he is evidently very doubtful on the subject. Richardson doubts the assertion altogether that animals resort to earths or mineral waters as remedies. He also doubts whether animals avoid poisonous vegetables, except in instances where the substances they refuse are distinctly odorous. He adds that the evidence on the subject in favour of the animal over the man is very small when it is carefully analysed; and certainly in regard to the avoidance of poisons by the inferior animals, the faculty, "as he found by direct observation, is extremely limited." It extends only to the detection of odorous substances. Wallace believes that the statement as made by the author is "unfounded and erroneous." Lubbock doubts whether the word knowledge can be applied to animals, but agrees that their senses are "in some respects more acute; also, perhaps, very different from ours."

These are negative or opposing views to those expressed by Dr. Harris himself on the subject of the special faculties of the inferior animals. But he adds the opinions of other authors which go with his own on the point, and in some instances are more determinately expressed. The late Mr. Alfred Smee, Mr. Serjeant Cox, Dr. Carter Blake, and Mr. Wood are on the side of our author.

We have selected but one example of this incidental inflow of thought from other minds into Mr. Harris's pages. We could have found many more illustrations, some of which are of equal interest, and we have no doubt that in a future day, when all the writers are silent, as, alas! some already are, these footnotes will be quoted—as extracts from letters of past men are quoted now—as evidences of thought quite unpremeditated, but still as correct reflexes of the minds that gave them forth.

We turn to the chapter on "The Faculty of Genius," in the third book as a good illustrative type of the chapters generally. Dr. Harris here strives to fix a definition to the word genius. In accordance with his rule, he gives the definitions of many scholars and metaphysicians respecting genius, and thereupon he adds his own definition. "The faculty of genius," he says, "may be defined to be that power of the mind whereby it is able to produce results which cannot be attained by the common and ordinary faculties for receiving knowledge and reasoning upon it." Genius, therefore, produces results which no exercise of common or ordinary faculties, however energetically they may be employed, could produce—results which are quite beyond the sphere of such ordinary faculties, "and of a nature altogether different from anything produced by them." "Thus," he continues, "while by understanding and reason we receive ideas and compare them, by genius we are enabled to create them anew altogether, through the original combinations which we accomplish. While the former faculties only enable us to import and to select our wares, the latter enables us to make them ourselves."

From this definition the author proceeds to state that the faculty of genius, like that of understanding and reason, will be found to be constituted of certain independent capacities. These he classifies under different heads, viz., the capacity for wit; the capacity for taste; the capacity of organisation; and the illustration of the nature of these capacities, under the last of which heads there is appended a most interesting note by De Sainte Croix. Further on he writes under other heads, on the distinctive functions, operations and appliances of each of the different capacities of genius; the corresponding characters in the action of each of these capacities; on art as the especial province of the faculty of genius; on the extent and limit of the operations of genius.

Here, in summary, is the scope of this essay of our author on genius. From his point of view, that genius is a special faculty belonging to a particular class of men, it is an admirable treatise in itself. It ought to have been supplemented by a special chapter on genius in relation to families and races, without which chapter it may be considered, by some, to be diffuse, uncemented, and unsymmetrical; an edifice that may easily fall down and is not artistically laid out. For all that it is a commanding construction, wanting in genius but elaborate in labour. It is, in fact, a striking illustration of one of the author's own definitions. The best part of the essay is that in which the attempt is made to prove that the faculty of genius is especially connected with art. It will occur to all who think on this matter that there is in the idea a subject for careful consideration. If it should be true, the admission of its truth would lead to considerable modification in historical appreciations of work in science. It strikes us at once, as we glance back at the history of science, that the true men of genius in science have all been strongly imbued with artistic feeling and knowledge, and it strikes us also that some men who are known only as artists in literature or painting, or other true art, have made very singular and original contributions to science. But the theme is too fruitful of suggestion to be followed out here. We leave it for the study of those who have leisure as well as learning.

We replace Dr. Harris's volumes on our shelves in a convenient place for handy reference, and we commend others who have to think, write, and speak on the subjects submitted for study to do the same. They will often find the matter most useful as well as interesting, and although at times they may wish that the exposition had been less laboured, they will be grateful to an author who has spared neither time, nor labour, nor expense, to give them "the work of his life." We add, without hesitation, that Dr. Harris's work, though it be little read in this age of luxurious reading, will remain to be read as one of the solid and enduring additions to English learned literature.

SCIENCE IN THE ARGENTINE REPUBLIC

The Argentine Republic. Written in German by Richard Napp, assisted by several Fellow-writers, for the Central Argentine Commission on the Centenary Exhibition at Philadelphia. With several maps. (Buenos Ayres, 1876.)

Physikalische Beschreibung der argentinischen Republik, nach eigenen und den vorhandenen fremden Beobachtungen entworfen. Von Dr. Hermann Burmeister. Erster Band: die Geschichte der Entdeckung und die geographische Skizze des Landes enthaltend. (Buenos Aires, 1875.)

Acta de la Academia Nacional de Ciencias Exactas existente en la Universidad de Córdova. Tomo I. (Buenos Aires, 1875.)

Los Caballos Fósiles de la Pampa Argentina. Descriptos por Dr. Hermann Burmeister, Director del Museo Público de Buenos Aires. Obra ejecutada por órden del Superior Gobierno de la Provincia de Buenos Aires, para ser presentada en la Exposicion de Filadelfia. Con viii. Láminas Litografiadas. (Buenos Aires, 1875.)

ON several previous occasions [1] we have alluded to the excellent work in science accomplished by Prof. Burmeister, or under his supervision, since that eminent German naturalist took up his residence in the Argentine Republic. A batch of books, which has now, we regret to say, been lying before us for some time, testifies to his unabated activity in the good cause, and requires a few words of acknowledgment and explanation. The first of these, originally written in German by Richard Napp, but translated for the benefit of the Anglo-Americans, gives a general physical and commercial account of the Argentine Republic, prepared on the occasion of the Centenary Exhibition at Philadelphia. It is, of course, rather superficial, as is usually the case with such essays, but contains a good deal of information, and will be useful to the many Anglo-Saxons who are now settling in various parts of the country of which it treats.

Next we have the first volume of a complete physical description of the Argentine Republic, by Dr. Burmeister himself, which when finished will, as we understand from the introduction, contain a much more complete account of this extensive territory and its products than any work that has yet appeared. The present portion of it gives us the history of the discovery of the country and an account of its physical geography. Subsequent volumes will contain a general *résumé* of its natural history and geology. A French edition as well as a German will be issued, and a folio atlas will contain the necessary illustrations.

The third work on our list is the first volume of the "Acta" of the National Academy of Sciences of Cordova, which, as we have explained to our readers on former occasions, has been recently re-constituted under Dr. Burmeister's directorship. It contains contributions to science by some of the members of the new professoriate, the organisation of which has caused our excellent friend so much embarrassment. Dr. Stelzner and Dr. Brachebusch treat of various points in the geology and mineralogy of the Argentine Republic. Dr. D. C. Berg contributes an essay on the Lepidoptera of Patagonia, based upon collections made during an excursion to that country in 1874.

Lastly, we have an excellent memoir by Dr. Burmeister on the Fossil Horses of the Pampas formation written in Spanish and German, and prepared, as it appears, on the occasion of the International Exhibition of Philadelphia. Eight well-executed lithographic plates illustrate this important work, which is executed in the same style as other excellent essays of the indefatigable author that we have already noticed on former occasions. An Appendix contains a complete list of the mammals of the Quaternary Pampian formation, remains of which are contained in the Public Museum of Buenos Ayres. From this it appears that between fifty and sixty species are represented more or less perfectly in this unparalleled series, amongst which are many specimens that, in spite of the richness of our own palæontological collections, might well excite the envy of Prof. Owen and Mr. Waterhouse.

[1] NATURE, vol. iii. p. 282; vol. vii. p. 240; and vol. xii. p. 145.

OUR BOOK SHELF

United States Commission of Fish and Fisheries. Part III.—Report of the Commission for 1873–74 *and* 1874–75. (Washington Government Printing-office, 1876.)

THIS volume is quite as interesting as any of those which have preceded it, whilst the amount of reliable information it brings to a focus, not only regarding the fish and fisheries of the United States, but of the fisheries of Great Britain, Sweden, Prussia, Holland, France, and Russia, is remarkable; nor are the historical observations on the condition of the fisheries among the ancient Greeks and Romans, and on their modes of salting and pickling fish less interesting. The volume is throughout so rich in statistics and details of piscicultural labour that we feel embarrassed as to what part of it to notice first; to give a detailed account of the contents is simply impossible in anything like the space we can afford. As readers of NATURE may be aware, the present volume is one of a series having for its object an exposition of the present state of the American fisheries, and in particulur showing the extent to which the seas and waters of the United States have been over-fished, and how far the systems of artificial fish culture at present in vogue provide a remedy for the reckless spoliation of the waters which has been going on for the last twenty years. Familiar as we are with the figures of fish-culture, so far as they are locally applicable to British enterprise, and whether in respect of oysters or salmon, any details we can give are utterly dwarfed by the fabulous-looking figures applicable to what has been achieved in America. The young salmon which have been thrown into the River Tay from the Stormontfield hatching-ponds since the beginning of the experiments in 1853 up to the present time, will not be equal to the operations of one season on the Upper Sacramento; in 1875 the salmon eggs collected numbered 11,000,000, making a bulk of eighty bushels, and weighing nearly ten tons! These eggs, so carefully packed that only a small percentage was wasted, have been largely distributed over America, and will doubtless ultimately add largely to the fish supply of the United States.

Another fish which has been subjected to the manipulations of the pisciculturists on a positively gigantic scale is the shad, *Alosa sapidissima*, and the fish locally known as the "alewife," *Pomolobus pseudo-harengus*. These fishes were at one time (forty years since) exceedingly abundant in the Potomac river, so much so that as many as 22,500,000 shad and 750,000,000 alewife were captured in six weeks' time. Only a small percentage of

these numbers can now be taken. Enormous quantities of shad have been bred from the egg and sent into the waters in order to renew the supply; many millions of healthy young fish are thus annually added to the stock, and fresh rivers are now being populated with shad.

Another fish to which the commission has of late directed its attention is the carp, *Cyprinus carpio*, and var. It is a fish which is thought to be eminently calculated for the warmer waters of America, and especially suited to the mill-ponds and sluggish rivers and ditches of the south. Some most interesting information is given about the carp and its numerous varieties, but it is too detailed for quotation. Another noteworthy feature of American fish-culture is the transport, in "an aquarium car," to the coast and inland waters of California, of various fishes and crustaceans of North America, in order to test the question of whether they could be acclimatised in the warmer latitudes of the Pacific. The first experiment failed through an accident on the railway, but on June 12, 1874, the car arrived safely with its interesting freight. Out of a lot of 150 lobsters which were placed in the aquarium car, only four, however, were left alive on reaching San Francisco Bay, and these were put into the sea at Oakland Wharf, nine days after they had been taken from the Atlantic Ocean. It is thought probable that the four specimens did not ultimately live, but as two of the four were big with spawn it is probable the eggs would come to maturity, as the death of the parent does not kill the spawn. Lobster eggs, unlike fish ova, are fructified before they leave the body of the animal.

An interesting account is given in the present volume of the American oyster fisheries.

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.]

Indian Rainfall and Sun-spots

SINCE my last communication to you on the above subject I have had some correspondence with Mr. Hill, the meteorological reporter to the North-West Provinces, in the course of which he has given me a more definite account of the results of his investigations. The outcome of our joint researches may be broadly stated as follows:—In years of maximum sun-spot the summer rainfall is *above* and the winter rainfall *below* the average, while in years of minimum sun-spot the reverse conditions hold, viz., the summer rainfall is *below* and the winter rainfall *above* the average.

Though the preceding hypothesis can only be considered at present in the light of a probability, it is considerably strengthened by the fact that, unknown to each other, Mr. Hill and myself have each taken it as the basis of our separate, and until recently, independent lines of inquiry. Mr. Hill has already sent in a short report to Government of the results of his own investigations, which he roughly states in the following words:—"I have examined the rainfall of Benares, Allahabad, Agra, Bareilly, Roorkee, Dehra, Mussoorie, and Naini Tal, since 1861, and I find that on the average the *total* annual rainfall of the maximum sun-spot years 1861, 1869, 1870, and 1871, is about 14 per cent. above the average for the whole period, and that of the minimum group 1866, 1867, and 1868, about 4 per cent. below it. On the other hand, when only the *winter* rainfall is considered, the defect in maximum sun-spot years is about 21 per cent. of the average winter fall, and the excess in minimum sun-spot years is above 20 per cent." Unfortunately no further data appear to be available in the North-West Provinces, as during the mutiny decade, 1851–1860, no register was kept, and before the mutiny the Schlagintweits took away to Germany most of the old rainfall records. The results, however, as far as they go, are in complete accordance with those I have obtained from a similar comparison of some of the rainfalls in Bengal.

The chief obstacles in the way of making a thoroughly complete and exhaustive comparison of the rainfalls throughout Northern India are (1) the paucity of registers, and (2) the limited periods over which they extend. In the single case of Calcutta the latter objection does not apply, since by dint of some trouble I have succeeded in obtaining the monthly as well as the annual falls for a period of forty years, from 1833 to 1876 inclusive. As this comprises four complete sun-spot cycles, the results are extremely valuable, especially as they tend to exhibit what Prof. Balfour Stewart considers to be the true test of a physical cycle, viz., its repetition.

I here append a comparison of the rainfall of Calcutta, for the months of January, February, and March, arranged in four groups of minimum and maximum sun-spot years, together with the years immediately preceding and following them (except in the case of the former, where the rise after the minimum is often very rapid).

Minimum sun-spot groups.		Maximum sun-spot groups.	
Years.	Total of each group.	Years.	Total of each group.
	inches.		inches.
1842, 1843, 1844	7·80	1836, 1837, 1838	3·54
1854, 1855, 1856	7·29	1847, 1848, 1849	6·68
1865, 1866, 1867	12·89	1859, 1860, 1861	6·42
1875, 1876, 1877	14·60	1869, 1870, 1871	9·76
Total of all the groups.	42·58	Total of all the groups.	26·40

In addition to this it may be noted that the total fall during the same three months of the four absolute minimum sun-spot years 1843, 1856, 1867, and 1877 (probable minimum) is 15·98 inches, while that of the four absolute maximum sun-spot years, 1837, 1848, 1860, and 1870, reaches only the insignificant amount of 2·48 inches. Similar results are obtained if the month of April and the months of November and December of the preceding years are respectively included, thus evidently showing that the relation is one connected with the seasonal distribution of the rainfall and not merely a coincidence, resulting from having taken the rainfalls of special months.

If we treat the rainfall of Dehra, from 1861 to 1877, in a somewhat similar manner, by taking the rainfalls of January, February, and the previous December, and consider 1861, 1862, and 1863 to approximately represent a maximum group, the results are as follows:—

Minimum sun-spot groups.		Maximum sun-spot groups.	
Years.	Total of each group.	Years.	Total of each group.
	inches.		inches.
1865, 1866, 1867	22·1	1861, 1862, 1863	2·6
1875, 1876, 1877	13·3	1869, 1870, 1871	10·5

I think an examination of the preceding comparisons of the winter rainfalls of Dehra and Calcutta (rough though they undoubtedly are) discloses distinct evidence of repetition in

unison with the sunspot periods, at all events enough to warrant further and more complete investigations being made on the point. I will not trespass on your valuable space further than to add a similar rough indication of the inverse relation that holds in the case of the summer rainfalls. They will be seen to be greatest in years of maximum sunspot.

In the following groups the rainfall of Dehra is taken for the months of June, July, August, September, and October during which the south-west monsoon rains fall. I give the separate rainfall during these months for each year, as well as the totals and averages.

Maximum sun-spot groups.			Minimum sun-spot groups.		
Years.	Inches.	Totals.	Years.	Inches.	Totals.
1861	91·4	181·9	1875	67·2	143·3
1862	90·5		1876	76·1	
Average for each year		90·9	Average for each year		71·6
1869	70·5	247·9	1865	58·9	186·5
1870	77·2		1866	67·0	
1871	100·2		1867	60·6	
Average for each year		82·6	Average for each year		62·1

The averages give a mean average excess in each year in the maximum sun-spot groups of 19·9 inches over each year in the minimum groups; a gigantic difference certainly, and apparently maintained pretty consistently throughout by the rainfall of each year. The defect in the winter rainfall of years of maximum sunspot and the corresponding excess in years of minimum sun-spot together combine to render the excess in years of maximum sun-spot less apparent in the total annual falls, though it still exists to a certain extent. The present year (at present abnormally deficient in solar activity) appears destined to fulfil the preceding relations to an alarming extent. The winter rainfall was unusually plentiful throughout Northern India, while, up to the present time, when the monsoon should be in full swing, the rains, except in Eastern Bengal, have been so scanty that unless rain falls soon and abundantly, we shall have to face a famine as fearful as that which is just now devastating Madras.

E. D. ARCHIBALD

Greening of Oysters

IT has long been known that oysters, when removed from the sea and kept artificially in shallow pits filled with salt-water, assume a green colour which is or was much thought of by epicures. While this spring at Le Croisic, at the mouth of the Loire, my friend, Dr. Bornet, informed Prof. Lankester and myself that this singular change was particularly observable in the oyster preserves in the neighbourhood. He was at that time at a loss for an explanation, but I have just received a letter from him in which he gives the solution of the problem, and this will I think be so interesting to many of the readers of NATURE, that I have ventured, although without his permission, to communicate it to them.

"As a souvenir of our meeting at Croisic, I send you some *Corallinaceæ* from that locality. Several have not yet been detected on the English coast, where, however, they ought to occur. I have added a Diatom, *Navicula fusiformis*, Grunow, var. *ostrearia*. This species, whose contents are of a cobalt-blue colour during life, occurs in profusion in the oyster-preserves of Croisic, and it is because they feed on this Diatom that they become green. Nothing is easier than to demonstrate the fact by placing white oysters in a plate of sea-water containing nothing but *Navicula fusiformis*, and the "greening" takes place in thirty-six hours. As often as the experiment is repeated, the same result follows. But why should *Navicula fusiformis* be blue, while all other Diatoms are colourless?"

W. T. THISELTON DYER

P.S.—Since this note has been in type Prof. Oliver has called my attention to a paper in the "Mémoires de la Société Linnéene du Calvados," 1824, pp. 135-158, by Benjamin Gaillon, "Sur la cause de la coloration des Huîtres et sur les Animalcules qui servent à leur nutrition." These animalcules form masses which he compares to the green matter of Priestley, and as he refers them to the genus *Navicula* of Bory, they are no doubt identical with those which Dr. Bornet has studied. Gaillon refers to an earlier memoir of his own on the same subject published by the Academy of Sciences of Rouen, and in the *Annales des Sciences Physiques*, for 1821. W. T. T. D.

Reproduction by Conjugation

THE phenomenon to which Mr. Bennett alludes is, I presume, well known; but it is not universal, though common. He will find illustrations in Hassall's "British Freshwater Algæ," where the zygospores are formed in both filaments simultaneously; *e.g.*, plate 19, *Zygnema* (Spirogyra); plate 38, several species of *Tyndaridea*. But in those genera in which the Zygospore is formed *between* the filaments it would seem impossible to decide which is male and which is female, *e.g.*, plate 39, *Tyndaridea conspicua, immersa, Ralfsii*, and *decussata*; or in the genera *Mesocarpus*, plates 42-47, and *Stenocarpus*, plates 47-49.

GEORGE HENSLOW

Strange Dream Phenomenon

AFTER reading the interesting letter on a "Strange Dream Phenomenon" which appeared in NATURE (vol. xvi. p. 329) it occurred to me that it might be worth while to put on record the following experience which connects in a very striking manner the phenomena of dreaming and subjective vision. Some time ago, when rather tired by overwork, I dreamt during the night that some one had entered my bedroom and was approaching the pillow under my head with the intention of abstracting some valuable papers which I fancied were concealed beneath it. I noticed in every particular the dress, stature, and features of the intending robber, but just as he put forward his hand towards the bed I began to awake, slowly at first, but with great celerity as soon as I perceived the figure of my dream walking slowly down the side of the bed; wide awake now, I watched it reach the corner bedpost, turn round, and with measured noiseless step pass along the foot, till on coming between the window and myself it disappeared, as all the "ghosts" with which I was then afflicted were wont to do when shone through by the light.

I did not sleep any more for the rest of the night, and hence am perfectly certain that this was not "a dream within a dream," but a clear case of a subjective vision prolonged from the sleeping into the waking state, and thus affording evidence to prove the essential identity which underlies the phenomena of "dreaming dreams" and seeing "ghosts." W. J. S.

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF MARS.—The Paris correspondent of the *Times*, writing on August 27, states that at the meeting of the Academy of Sciences the same day, M. Faye had announced the independent discovery of the satellites of Mars by M. Borrelly at Marseilles, claiming for him even an earlier detection than was effected at Washington. Prof. Watson's name being introduced as the American discoverer instead of that of Prof. Asaph Hall, it is clear that the statement has arisen from a misconception on the part of the reporter at the sitting of the Academy, who has confounded the discovery of No. 174 of the minor-planet group, by Watson and Borrelly, with that of the satellites of Mars.

A letter from Rear-Admiral Rodgers, Superintendent of the Naval Observatory, Washington, to the Secretary of the Navy, dated August 21, furnishes particulars of the observations and calculations bearing upon both satellites, which had been made up to that date. The outer satellite was remarked on the 11th, but its true character was not certainly recognised until the 16th. On the following night Prof. Hall first observed the inner satellite. The discoveries were telegraphed to Messrs. Alvan Clark and Sons, at Cambridgeport, on the 18th, that confirmatory evidence of the existence of the satellites might be obtained by means of the 26-inch telescope of Mr. McCormick, at present in the hands of those eminent opticians, who succeeded in verifying Prof. Hall's discovery, as did also Prof. Pickering and his assistants at Cambridge, Mass. On the 19th the discovery was

communicated to the Smithsonian Institution, and by it, to the European observatories.

We subjoin the principal results of Prof. Newcomb's calculations on the first ten days' measures, extracted from a circular for which we are indebted to the superintendent of the U.S. Naval Observatory.

For the outer satellite Prof. Newcomb finds :—

Major axis of apparent orbit at distance [9·5930]	82″·5
Minor axis ,, ,, ...	27″·7
Major axis of orbit at distance unity...	32″·3
Position angles of line of apsides of apparent orbit...	70°...250°
Passage through west apsis (p=250°)...Aug. 19 at	16h·6 W.M.T.
Inclination of true orbit to the ecliptic	25°·4
Longitude of ascending node	82°·8
Period of revolution	30h. 14m.
Hourly motion in areocentric longitude	11°·91
These elements give for the mass of Mars	1 / 3,090,000

For the inner satellite Prof. Newcomb finds—

Major axis of apparent orbit at distance [9·5930]	33″·0
Passage through eastern apsis (p=70°)...Aug. 20 at	13h·0 W.M.T.
Period of revolution	7h. 38m·5
Hourly motion in areocentric longitude	47°·11

If we refer the position of the orbit of the first satellite to the earth's equator, the ascending node will be found to be in 46°·4, and the inclination 36°·2. The real distances of the satellites from the centre of Mars are about 14,500 and 5,800 miles respectively.

Prof. Newcomb, writing to the *New York Tribune* on August 22, gives some particulars relating to the new satellites. He remarks that the first question which will naturally arise is, Why have these objects not been seen before? The answer is that Mars is now nearer to the earth than he has been at any time since 1845, when the great telescopes of the present day had hardly begun to be known. In 1862 when Mars was again pretty near to the earth, we may suppose that they were not looked for with the two or three telescopes which alone would have shown them. In 1875 Mars was too far south of the equator to be advantageously observed in these latitudes. The present opportunity of observing the planet is about the best that could possibly occur. At the next opposition in October, 1879, there is hope that the satellites may be again observed with the great telescope at Washington, but Prof. Newcomb thinks that during the following ten years, when owing to the great eccentricity of the orbit of Mars, he will be much further from the earth at opposition, the satellites may be invisible with all the telescopes of the world. In the present year it is hardly likely that they will be visible after October. The satellites may be considered as by far the smallest heavenly bodies yet known. "It is hardly possible to make anything like a numerical estimate of their diameters, because they are seen in the telescope only as faint points of light. But one might safely agree to ride round one of them in a railway car between two successive meals, or to walk round in easy stages during a very brief vacation. In fact, supposing the surface of the outer one to have the same reflecting power with that of Mars, its diameter cannot be much more than ten miles, and may be less. Altogether these objects must be regarded as among the most remarkable of the solar system." Prof. Newcomb further points out that we may regard M. Leverrier's mass of Mars as the product of a century of observation, and several years of laborious calculation by a corps of computers, while from the measures on four nights of the new satellites, ten minutes' computation gives a mass which is in striking agreement with that of the illustrious astronomer of Paris.

THE D'ANGOS COMET OF 1784.—In continuation of our remarks upon this object, so long considered apocryphal (NATURE, vol. xvi. p. 124), we proceed to notice an investigation by D'Arrest, undertaken in 1865. He refers to a somewhat confused note in Cooper's "Catalogue of Cometic Orbits," where the orbit given by D'Angos is introduced "with no slight misgivings," though the writer thought his note was "considerably opposed to Encke's statement," on what precise grounds, however, is not very apparent. And D'Arrest considered the essay in Zach's work may have received undue colouring from the editor, and a further proof of the non-existence of the comet is required.

Deducing the sun's places from the Tables of Hansen and Olufsen, D'Arrest compares the fourteen days' observations given by D'Angos in Bernouilli's and Hindenburg's Magazine, with the best of two orbits calculated by Olbers from them, and finds what he terms "horrenden Abweichungen." A similar comparison by means of elements selected from numerous sets computed by himself, exhibits also great differences, so that his first conclusion is identical with that arrived at by Olbers and Encke, the comet's places are irreconcilable with parabolic motion about the sun. On applying the general method of the *Theoria motus* he was led to extraordinarily small distances from the earth, in perfect agreement with the results obtained by Encke on a different method of procedure.

D'Arrest then introduces the consideration of the *geocentric hypothesis*. We are certain of cases where the orbits of comets have undergone an entire change through the action of the planet Jupiter, and there is now, he urges, no difficulty in accepting the idea of an insignificant and small vaporous mass, passing with a retrograde motion in such close proximity to the earth, that the case treated of in the "Mécanique Céleste," book ix. chap. ii., may enter. The question is a complicated one, and D'Arrest contents himself with examining whether in the series of observations of the comet, there is anything to contradict the hypothesis that for a time it was moving as a satellite of the earth. Necessarily omitting parallax, he finds on this geocentric assumption the following elements :—Time of passage by the perigee, April 15·13649 mean time at Paris ; ascending node 90° 52′ 9″ ; inclination 43° 8′ 23″ ; distance of perigee from ascending node 128° 7′ 59″ ; eccentricity 0·97320, and least distance from the earth in units of the semi-axis major of the moon's orbit 3·82290 ; motion, retrograde. When now the comet's distances from the earth are found from the observed angular motions, and again direct from the elliptical elements, a comparison shows that the angular motion with respect to the earth corresponds well with the law of areas, and the latitudes from this approximate calculation are sensibly better represented, than on the supposition of heliocentric motion.

The general conclusions arrived at by D'Arrest from his investigation appear to be these : that the impossibility of the observations published by D'Angos and the obvious imposition previously attributed to him are not in accordance with evidence. The comet may have been moving for a time virtually as a satellite of the earth, or while passing very near to it may yet have been without the sphere of attraction, the definition of which is perhaps somewhat arbitrary. The difficulty and uncertainty attending further research, and the expense of time and labour necessary, induced D'Arrest to rest satisfied with having thrown a more satisfactory light on the observations of the second comet of 1784, or at least of proving that a small body moving under certain conditions might have occupied the positions in the heavens attributed to it. We have yet to give some account of a paper by Gauss on this subject.

THE FIRST COMET OF 1877 (BORRELLY, FEBRUARY 8) —The elements of this comet, so far as yet published, appear to depend upon an interval of observation of eight

days only. The following orbit by Mr. Hind is founded on positions between February 8 and March 11 :—

Perihelion Passage, 1877, January 19·18369, G.M.T.

Longitude of Perihelion	200	4	18·0	M. Eq.
,, Ascending Node ...	187	15	7·0	1877·0
Inclination to Ecliptic...	27	5	24·1	
Log. Perihelion Distance	9·9071303			

Motion—retrograde.

There seems to be no sensible deviation from the parabola.

BIOLOGICAL NOTES

NEW WORK ON BIRDS.—We have received the prospectus of a new work by Dr. A. B. Mayer, Director of the Royal Zoological Museum of Dresden, to be entitled "Abbildungen von Vogel-Skeletten," in which he signifies his intention to publish, in parts, figures of the skeletons of rare or little-known birds. Each part is to contain ten plates of large quarto size, one of which, representing the skeleton of the extremely uncommon parrot from New Guinea, *Dasyptilus pecqueti* (Lesson) accompanies the prospectus. It is a photo-lithograph, and differs materially from any other which we have seen in one important particular, namely that the bones of one side only are depicted, which is a great advantage, as it prevents the confusion unavoidably associated with the representation of the whole structure. The illumination of each bone and the focus of every part is most satisfactory, more so in many respects than any drawing could possibly be. Short commentaries, with measurements, will accompany each plate. It is proposed that Part I. shall contain figures of *Loriculus cuiacissi*, *Charmosyna josephinæ*, *Meropogon forsteni*, *Paradisea papuana*, *Cicinurus regius*, *Manncodia chalybea*, *Ptilopus speciosus*, *Otidiphaps nobilis*, and *Gallus bachiva* (from Celebes). In the series is also to be included the skeletons of the several domestic pigeons and fowls. We hope that Dr. Mayer will have a large subscription to this valuable addition to ornithological literature.

THE BODY-CAVITY IN THE HEAD OF VERTEBRATES.—It has hitherto been regarded as a point of distinction between the mouth, throat, and gill region of vertebrates, and the rest of the trunk, that in the former no splitting of the body wall took place in early development, while in the trunk the body-wall becomes sharply separated from the contained viscera, and a cavity arises between them, part of which is the peritoneal cavity. Mr. Balfour (*Jour. Anat.*, April, 1877) has announced the discovery in sharks of a head-cavity on either side of the throat, dividing the growing tissue into an inner and an outer wall. When the visceral clefts (future gill-slits, &c.) appear, they subdivide these cavities into smaller ones. The head-cavity even grows forwards as far as the eye, and ultimately there is a series of cavities : (1) a premandibular, (2) a mandibular, (3) a hyoid, (4) a series in the branchial arches. These cavities ultimately atrophy, but their walls become developed into muscles, and they answer to the muscle-plates of the rest of the body. Thus this discovery gives information of a most valuable kind as to the segmental relations of the head to the rest of the body, besides furnishing a glimpse of a primordial condition in vertebrates which had till now remained unknown.

FISH-EATING BIRDS.—Mr. Joseph Willcox has recorded an interesting observation on the crow blackbirds of Florida (*Quiscalus purpureus*). Standing on the bank of a river in Florida, he noticed a commotion among a congregation of crow blackbirds, which were anxiously looking into the water. A large bass was pursuing its favourite food, the small fry, and the latter, in their frantic efforts to escape, jumped out of the water, and many of them fell on the land. The blackbirds, evidently experts at the game, immediately pounced upon the small fish, and swallowed them before they could get back into the water. (*Proc.* Acad. Nat. Sci., Philadelphia, 1877.)

ANTS' DOMESTIC ANIMALS.—Prof. Leidy (Philadelphia) has observed colonies of *F. flava* in possession of several kinds of insects at once. A comparatively small assemblage of them had three groups, an aphis, a coccus, and the larva of an insect, apparently coleopterous. The aphides were kept in two separate herds, and these were separated from a herd of cocci. In a larger colony of ants there was a collection of aphides occupying the under part of one margin of a stone, for ten inches long by three-quarters of an inch wide. A distinct group of cocci, closely crowded, filled a square inch. They all appeared to be carefully attended to by the ants.

A WHALE IN THE MEDITERRANEAN.—M. P. J. Van Beneden has made a short communication to the Académie Royale de Belgique, published in that Society's *Bulletin*, with reference to a letter by M. Capellini, on a true whale captured in the Mediterranean Sea, near Taranto. The Italian author suggests the new specific name *Balæna tarantina*, but M. Van Beneden much more reasonably thinks it most probable that it is a stray specimen of *B. biscayensis*.

THE LATE MR. GASSIOT

WE last week announced briefly the death of Dr. J P. Gassiot, and now give some account of the principal scientific results obtained by him. Mr. Gassiot, partner in the firm of Martinez Gassiot and Co., wine merchants, Mark Lane, first devoted his spare time to electrical experiments about the year 1838. An Electrical Society was formed about that time in which he took an active part. At one of the meetings it was observed that when the two copper wires forming the poles of a powerful voltaic battery were crossed and drawn asunder so that the voltaic arc passed between them, the positive terminal became heated to incandescence, while the negative remained comparatively cool. This excited great interest in Mr. Gassiot's mind and led him to make several experiments, but without thoroughly explaining the phenomenon. In the course of these experiments he procured powerful batteries, first of Daniell's construction, then of Grove's, and ultimately a large water battery.

It had been observed by many writers (principally Continental) that while the dynamic and chemical effects of the voltaic battery increased in intensity in proportion to the increasing chemical action in the cells of the battery, the static effects, such as the repulsive action in a gold leaf or pith ball electroscope, the spark, the power of charging a Leyden phial, &c., were more intense when the battery was charged with water and had consequently but a feeble chemical action in the cells. This anomaly puzzled electricians much, and though sought to be explained by various hypotheses, was a great stumbling-block in the way of the chemical theory of the voltaic battery.

Mr. Gassiot had been led to attach great value to good insulation between the cells of the battery, and he procured to be made a Grove battery (the most powerful chemical battery known) of 100 glass cells, all having long glass stems, and separated from each other. This battery gave very powerful chemical results, and a voltaic arc of great brilliancy ; but, what was of the greatest importance, he found that with this battery the static effects, or effects of tension, were greater than those of an equally-sized water battery. The puzzling anomaly was thus explained : the reason why the chemical battery had seemed inferior in tension to the water battery was that from the effervescing liquids, the close approximation of

the cells, and their being moistened with good conducting liquids, insulation was destroyed, and no static effects at the terminal, or very feeble ones, were perceptible. This result, by far the most important of Mr. Gassiot's labours, was published in the *Phil. Trans.* of the Royal Society for 1844, p. 39. It got rid of the strongest objection to the chemical theory of the pile, and brought into harmony results which up to that time had appeared discordant.

In 1852 Mr. Grove had published in the *Phil. Trans.* of the Royal Society, in a paper "On the Electro-Chemical Polarity of Gases," an account of transverse dark bands or striæ, which he was the first to observe in the electric discharge. The discharges were obtained from a Ruhmkorf coil, and made to pass through attenuated gases, or what were commonly called *vacua*. Mr. Gassiot made a vast number of experiments on these striæ, the most important of which was that he obtained them in a Torricellian vacuum with the voltaic arc, showing that they did not depend on the intermittence of the discharge (occasioned by the contact-breaker), but accompanied all electric discharges *in vacuo*. There is, perhaps, some doubt whether the voltaic arc is absolutely continuous, or whether it does not produce, by its action on attenuated gas, something like waves (a stone thrown into water may be a rough simile), but at all events it is continuous in its inception, and in that respect quite different from the interrupted discharges of the contact-breaker apparatus, or the common electrical machine.

Mr. Gassiot devoted himself for a long time to procuring *vacua* as perfect as they could be obtained, for the examination of the electric or voltaic discharges, and proved distinctly that when the attenuation was pushed to a high degree of rarity, the electric discharge would not pass at all, a result which had been observed by Morgan (*Phil. Trans.*, vol. lxxv.), the accuracy of whose experiments was impugned by Davy.

Mr. Grove, as an answer to the contact theory of the voltaic pile, had shown that if two polished plates, one of zinc, the other of copper, were approximated, but kept from contact by a thin film of paper or mica, and then separated, the electric effects, alleged to be due to the contact of dissimilar metals, were produced; it was objected to this experiment, and not without reason, that these effects might be produced by friction of the paper or mica. Mr. Gassiot effectually got rid of this objection by bringing the plates into close proximity by a delicate micrometer apparatus and then quickly separating them; the same electrical results followed (*Phil. Mag.*, October, 1844).

The above are the principal of many curious results obtained by Mr. Gassiot. While thus giving up his leisure time to science, he was a diligent and successful man of business and a liberal promoter of, and contributor to, all useful scientific and benevolent objects, some of which we mentioned in our previous notice.

THE SPECTRUM OF NOVA CYGNI

IN the *Monatsbericht* of the Royal Academy of Sciences of Berlin (May, 1877), Herr Vogel, the eminent astronomer, publishes the details of his investigations of the spectrum of the new star in Cygnus, and whilst expressing his own views with regard to the physical condition of the star, enters upon a criticism of those of other observers. Herr Vogel observed the spectrum on sixteen different nights; the first observation was made on December 5, when the star was of 4·5 magnitude; the last on March 10, when the magnitude was only 8·3.

Herr Vogel's observations show that the spectrum of the new star was a continuous one, showing numerous dark lines and bands and several bright lines. The intensity of this continuous spectrum, which at first was very brilliant, decreased rapidly, so that three months after the discovery of the star it was only partly visible, and even that part was very faint. The decrease of intensity did not spread evenly over the whole spectrum; the blue and violet rays grew fainter far more rapidly than the green and yellow rays. The red part of the spectrum, which already during the first observations was very dim and crossed by broad absorption bands, soon disappeared altogether, so that a bright line in the red seemed to remain quite isolated. At first a dark band in the green, and, later on, a very broad dark band in the blue, were particularly conspicuous. With the exception of a bright line in the red, the other bright lines at first surpassed the continuous spectrum but very little in brilliancy; they could therefore be seen only with difficulty. During the rather rapid decrease of intensity of the continuous spectrum they, however, became more easily discernible, and, as results from the measurements made, the hydrogen lines Hα and Hβ were particularly bright, and, later on, a line of 499 mill. mm. wave-length. This latter line remained longest when the spectrum faded away, and finally surpassed the hydrogen lines in intensity; the red hydrogen line was the first to grow fainter. The weather not having been very favourable, the measurements which Herr Vogel made have no claim to very great accuracy, but they at least prove that the following *bright* lines have appeared in the spectrum:—

1. The hydrogen lines $\left.\begin{matrix} H\alpha \\ H\beta \end{matrix}\right\}$ beyond doubt.
   Hγ most probably.
2. A line of 499 mill. mm. wave-length (± 1 mill. mm.). This line coincides tolerably well with the brightest line in the nitrogen spectrum under ordinary pressure; it is the same line which is brightest in the spectra of nebulæ.
3. An indistinct line of 580 m. mm. wave-length.
4. An indistinct line of 497 m. mm. wave-length. This nearly coincides with a close group of lines in the atmospheric spectrum.
5. Some bright lines were seen in the neighbourhood of *b* and *E*, but their position could not be measured. On December 5 two lines were measured in the blue (of 474 and 470 wave-lengths), and were also observed on December 8, but, later on, only the second one has again been seen as an indistinct band of 467 wave-length.

In the accompanying illustration (Fig. 2) we reproduce Herr Vogel's drawings, which supplement his observations, and, as he points out, contain many a detail which could not well be described in words.

Herr Vogel, in discussing the views of other astronomers, first deals with M. Cornu's observations. M. Cornu made his first observations on December 2 and 5 (see NATURE, vol. xv. p. 158); he succeeded in measuring several bright lines in the spectrum, viz., wave-lengths, 661 (H*a*), 588, 531, 517, 500, 483 (H*β*), 451, 435 (H*γ*). He saw no dark bands distinctly in the continuous

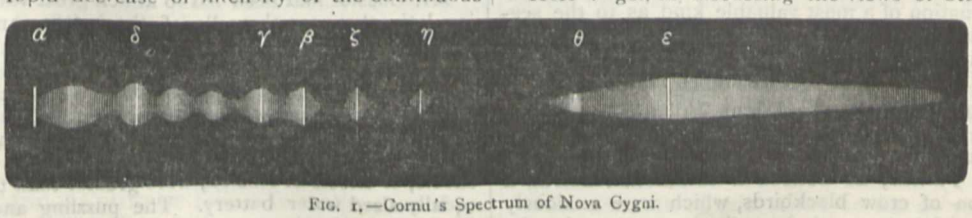


FIG. 1.—Cornu's Spectrum of Nova Cygni.

spectrum, "because," says Herr Vogel, "he doubtless observed with a spectroscope of too great a power of dispersion, and therefore many details escaped his notice. This supposition is confirmed by the drawing, published in the *Comptes Rendus* (t. 83, p. 1,172), where M. Cornu represents the spectrum as consisting of two parts, and, which contains no other details besides the bright lines'

As the line 588 wave-length, measured in the star spectrum, corresponds closely with D_3, also the line 531 wave-length, with the well-known corona line (531,6 wave-lengths) and finally the line 517 wave-length, with the middle of the magnesium lines *b*, M. Cornu draws the conclusion that with regard to chemical composition the atmosphere of the star coincides completely with the chromosphere of our sun: "en résumé, la lumière de l'étoile parait posséder exactement la même composition que celle de l'enveloppe du soleil, nommée chromosphère." Herr Vogel, however, thinks that this conclusion is not altogether justified, since a line (500 wave-length), which does *not* occur in the chromosphere was distinctly visible with the other bright lines in the spectrum, and it eventually became the *brightest* line of the whole spectrum. Comparing his own observations with those of M. Cornu, Herr Vogel points out that they agree perfectly with regard to the presence of the three hydrogen lines, and that of the brightest line of the atmospheric spectrum, or the principal line of the nebulæ spectrum (500 wave-length). He could not determine the position of the bright green lines with sufficient exactness; on one day he found for them 527 and 514 wave-lengths respectively, but these figures differ considerably from M. Cornu's; this is still more the case with the lines in the blue, for which he finds 466 wave-length, while M. Cornu has 451 wave-length. The line 588 wave-length of M. Cornu was observed by Herr Vogel on one occasion, but was not again seen afterwards.

Father Secchi, in a short note in the *Astronomische Nachrichten* (No. 2,116), says that M. Cornu's description of the spectrum of the new star is correct, with the exception that the bright lines were not indistinct but

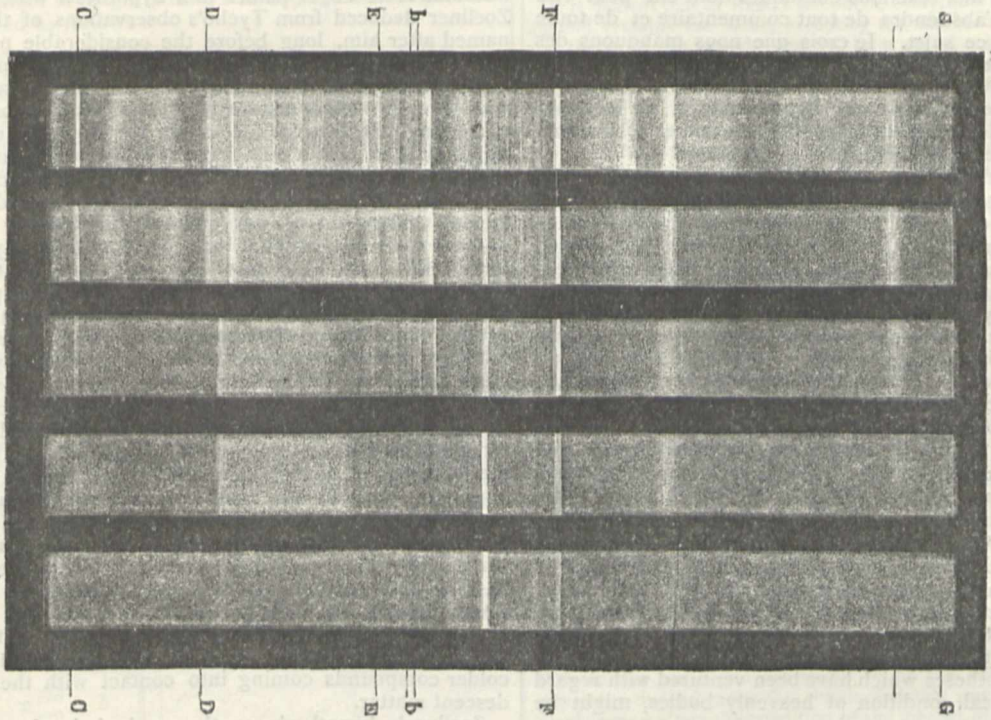


FIG. 2.—Vogel's Spectrum of Nova Cygni.

well defined, like lines in spectra of nebulæ. Father Secchi observed on January 7 and 8, when Herr Vogel also saw the lines well defined. He is very positive that one of the bright lines is a hydrogen line, another a magnesium line, and a third a sodium line; this, in Herr Vogel's opinion, is decidedly a mistake, because on January 8 the lines in the vicinity of the magnesium group were quite faint, and no bright line near *D* was to be seen. According to Herr Vogel, the bright lines which Father Secchi saw were a considerable distance away from the sodium and magnesium groups respectively, their wave-lengths being 500 and 580.

Mr. Copeland, who worked with a star spectroscope of Herr Vogel's construction, which was connected with the 15-inch refractor of Lord Lindsay's observatory, made the first observation on January 2, when the star was of 7th magnitude. He found the spectrum to be remarkably bright and consisting of a faint, continuous spectrum, crossed by five bright lines, of which he determined the following wave-lengths:—(1) 655, intense bright red; (2) 581, middle of a rather bright band in the yellow, fading off rapidly on both sides; (3) 504, and (4) 486, bright, well-defined lines; (5) 456, faint line in the violet. Nos. 1 and 4 are the hydrogen lines; No. 3 is the brightest line of the nebulæ spectrum. On January 9, when the atmosphere was particularly favourable, Mr. Copeland observed two other lines, of 594 and 414 wave-lengths respectively. The first was a "very narrow line," the second "excessively faint, but still certainly and repeatedly seen." In the vicinity of about 525 wave-length, Mr. Copeland observed the maximum of intensity of the continuous spectrum. Mr. Copeland's observations agree very well with those of Herr Vogel; the only exception being the violet line (456) for which Herr Vogel found a greater wave-length. Line 414, observed by M. Copeland, may possibly have been the fourth hydrogen line Hδ, if 414 is not a mistake of the printer and should be 434, as it would be strange if Mr. Copeland had not seen the third hydrogen line Hγ (434) which was distinctly visible. Mr. Copeland pointed out that the line of 580 wave-length corresponds closely with a line which Herr Vogel observed in the spectra of three faint stars, also belonging to Cygnus, which have quite abnormal spectra,

and Herr Vogel owns that, however small the similarity between these spectra and that of the new star may have been at first, a certain resemblance appeared when the latter grew fainter; not only the line in question coincided with one in these spectra, a coincidence was also evident in a maximum of brightness in the blue (467 wave-length) and in a dark broad band close to this maximum.

Mr. Backhouse, of Sunderland, observed the spectrum on January 26, and found the brightest line to be of 503 wave-length. He remarked in a note to NATURE (vol. xv. p. 295), that at the end of December, not this line but line F was brightest; Herr Vogel's observations quite agree with those of Mr. Backhouse.

In summing up and in his final remarks on this subject, Herr Vogel first of all declares that he cannot agree with M. Cornu's view as expressed by this observer in the following phrase:—"Malgré tout ce qu'il y aurait de séduisant et de grandiose à tirer de ce fait des inductions relatives à l'état physique de cette étoile nouvelle, à sa température, aux réactions chimiques dont elle peut être le siège, je m'abstiendra de tout commentaire et de toute hypothèse à ce sujet. Je crois que nous manquons des données necessaires pour arriver à une conclusion utile, ou tout au moins susceptible de controle; quelque attrayantes que soient ces hypothèses, il ne faut pas oublier qu'elles sont en dehors de la science, et que loin de la servir, elles risquent fort de l'entraver."

Herr Vogel thinks that the fear that a hypothesis might do harm to science is only justifiable in very rare cases; in most cases it will further science, in the first place because it draws the attention of the observer upon things, which, without the hypothesis, he might have neglected. Of course, if the observer is so strongly influenced, that in favour of a hypothesis he sees things which do not exist—and this may happen sometimes—science may for a while be arrested in its progress, but in that case the observer is far more to blame than the author of the hypothesis. On the other hand it is very possible that an observer may—involuntarily—arrest the progress of science, even without originating a hypothesis, by pronouncing and publishing sentences which have a tendency to diminish the general interest in a question, and which do not place its high significance in the proper light. Herr Vogel is almost inclined to think that such an effect might result from the reading of the above phrase by M. Cornu, and is of opinion that nowhere better than in the present case, where in short periods colossal changes showed themselves occurring upon a heavenly body, the necessary data might be obtained for drawing useful conclusions, and the test of those hypotheses which have been ventured with regard to the physical condition of heavenly bodies, might be made.

A stellar spectrum with *bright* lines is always a highly interesting phenomenon for any one acquainted with stellar spectrum-analysis, and is well worthy of deep consideration. Although in the chromosphere of our sun, near the limb, we see numerous bright lines, yet only dark lines appear in the spectrum whenever we produce a small star-like image of the sun and examine it through the spectroscope. It is generally believed that the bright lines in some few star-spectra result from gases which break forth from the interior of the luminous body, and the temperature of which is higher than that of the surface of the body, *i.e.*, the same phenomenon we observe sometimes in the spectra of solar spots, where incandescent hydrogen, rushing out of the hot interior, becomes visible above the colder spots through the hydrogen lines turning bright. But this is not the *only* explanation. We may also suppose that the atmosphere of a star, consisting of incandescent gases, as is the case in our sun, is on the whole colder than the nucleus, but with regard to the latter is extremely large. Herr Vogel cannot well imagine how the phenomenon can last for any long period if the first hypothesis be correct. The gas breaking forth from the hot interior of the body will impart a portion of its heat to the surface of the body and thus raise the temperature of the latter; consequently the difference of temperature between the incandescent gas and the surface of the body will soon be insufficient to produce bright lines, and these will disappear from the spectrum. This view applies perfectly to stars which suddenly appear and soon disappear again, or at least decrease considerably in intensity, *i.e.*, for so-called *new* stars, in the spectra of which *bright* lines are apparent, if the hypothesis mentioned below is admitted for their explanation. For a more stable state of things the second hypothesis seems to Herr Vogel to be far more adapted; he thinks, therefore, that stars like β Lyræ, γ Cassiopeiæ, and others, which show the hydrogen lines and line D_3 *bright* on a continuous spectrum, with only small oscillations of intensity, possess very large atmospheres in proportion, consisting of hydrogen and the unknown element which produces the line D_3. With regard to the new star Herr Vogel points to a hypothesis which Herr Zoellner deduced from Tycho's observations of the star named after him, long before the considerable progress had been made in stellar physics by means of spectrum analysis. Zoellner supposes that upon the surface of a star, through the constant exhalation of heat, the products of cooling, which in the case of our sun we call sun-spots, accumulate in such a way that finally the whole surface of the body is covered with a colder stratum which gives much less light or none at all. Through a sudden and violent tearing up of this stratum the interior incandescent materials, which it incloses, must naturally break forth, and must, in consequence, according to the extent of their eruption, cause larger or smaller patches of the dark envelope of the body to become luminous again. To a distant observer such an eruption from the hot and still incandescent interior of a heavenly body must appear as the sudden flashing up of a *new* star. That this evolution of light may under certain conditions be an extremely powerful one, could be explained by the circumstance that all the chemical compounds which under the influence of a lower temperature had already formed upon the surface, are again decomposed through the sudden eruption of these hot materials, and that this decomposition, as in the case of terrestrial substances, takes place under evolution of light and heat. Thus the bright flashing up is not only ascribed to the parts of the surface which through the eruption of the incandescent matter have again become luminous, but also to a simultaneous *process of combustion*, which is initiated through the colder compounds coming into contact with the incandescent matter.

Zoellner's hypothesis on the gradual development of heavenly bodies, as he states it in his "Photometric Researches" (p. 231, &c.), has been confirmed *in its essential points* by the application of spectrum-analysis to the stars. We recognise the different states of cooling in the spectrum, and in the cases of some fainter stars we have distinct data that in the atmospheres surrounding incandescent bodies, chemical compounds may already form and continue to exist. The hypothesis on *new* stars is in no wise contradicted by the spectral observations made of the two new stars of 1866 and 1876. The very bright continuous spectrum and the bright lines, which at the beginning only slightly exceeded its brilliancy, could not be well explained if we only suppose a violent eruption from the interior, which again rendered the surface (or part of it) luminous, but are easily explained by the hypothesis that the quantity of light is considerably augmented through a simultaneous process of combustion. If this process is of short duration, then the continuous spectrum, as was the case with the new star of 1876, will very quickly decrease in intensity down to a certain limit, while the bright lines in the spectrum, which result from the incan-

descent gases that have emanated in enormous quantities from the interior, will remain for some time.

The observations of the spectrum show beyond doubt that the decrease in the light of the star is in connection with the cooling of its surface. The violet and blue parts decreased more rapidly in intensity than the other parts, and the absorption bands, which crossed the spectrum, have gradually become darker and broader.

Finally Herr Vogel regrets that the news of the discovery of the new star by Herr Schmidt was only known so late, as doubtless during the first few days most interesting changes must have occurred in the spectrum, while the star rapidly decreased in brightness. Herr Vogel recommends that in case of appearance of other new stars no time should be lost before spectral observations are made, and points out that even with small telescopes very useful results may be obtained, if care is taken that spectroscopes are used of sufficiently low power of dispersion.

The position of the new star with regard to two neighbouring stars of magnitudes 9·1 and 9·4 Herr Vogel has determined as follows :—

Nova − * 9m·1 (*Bonn. Durchmust*, + 42°, 4184)
1877·0 $\Delta\alpha$ = − 25s·00 $\Delta\delta$ = + 1′ 15″·4
Nova − * 9m·4 (*Bonn. Durchmust.*, + 42°, 4185)
1877·0 $\Delta\alpha$ = − 35s·34 $\Delta\delta$ = − 1′ 13″·2.

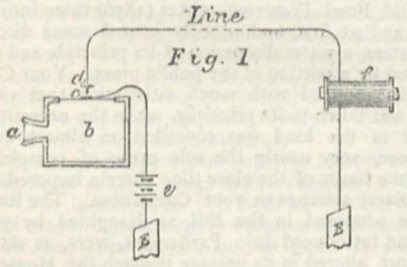
As the first of the comparison stars has been determined at the meridian circle of Bonn, the position of the new star is :—

1877·0, 21h. 36m. 52s·48 + 42° 16′ 54″·5.

THE TELEPHONE [1]

IN the following paper I call instruments employed in the transmission of musical sounds, tone-telephones, and those employed in the transmission of the human voice, articulating telephones.

In the year 1837, Page, an American physicist, discovered that the rapid magnetisation and demagnetisation of iron bars produced what he called "galvanic music." Musical notes depend upon the number of vibrations imparted to the air per second. If these exceed sixteen we obtain distinct notes. Hence, if the currents passing through an electro-magnet be made and broken more than sixteen times per second, we obtain "galvanic music" by the vibrations which the iron bar imparts to the air. The iron



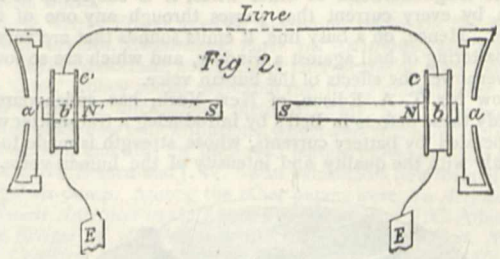
bar itself imparts these vibrations by its change of form each time it is magnetised or demagnetised.

De la Rive, of Geneva, in 1843, increased these musical effects by operating on long stretched wires which passed through open bobbins of insulated wire.

Philip Reiss, of Friedrichsdorf, in 1861, produced the first telephone which reproduced musical sounds at a distance. He utilised the discovery of Page by causing a vibrating diaphragm to rapidly make and break a galvanic circuit. The principle of his apparatus is shown Fig. 1.

b is a hollow wooden box into which the operator sings through the mouthpiece *a*. The sound of his voice throws the diaphragm *c* into rapid vibration so as to make and break contact at the platinum points *d* at each vibration. This interrupts the current flowing from the batteries *e* as often as the diaphragm vibrates, and therefore magnetises and demagnetises the electro-magnet as often. Hence whatever note be sounded into the box *a* the diaphragm *c* will vibrate to that note, and the electro-magnet *f* will similarly respond and therefore repeat that note.

Musical sounds vary in tone, in intensity, and in quality. The tone depends on the number of vibrations per second only; the intensity on the amplitude or extent of those vibrations; the



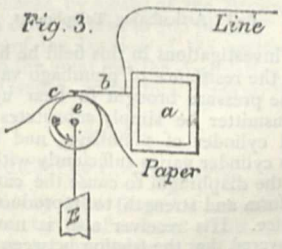
quality on the form of the waves made by the vibrating particles of air.

It is evident that in Reiss's telephone everything at the receiving end remains the same, excepting the number of vibrations, and therefore the sounds emitted by it varied only in tone and were therefore notes and nothing more. The instrument remained a pretty philosophical toy and was of no practical value.

Cromwell Varley, in 1870, showed how sounds could be produced by rapidly charging and discharging a condenser.

After alluding to the invention of Mr. Elisha Gray (NATURE, vol xiv. p. 30), Mr. Preece said :—

It remained for Prof. Graham Bell, of Boston, who has been working at this question with the true spirit of a philosopher since 1872, to make the discovery by which tone, intensity, and quality of sounds can all be sent. He has rendered it possible to reproduce the human voice with all its modulations at distant points. I have spoken with a person at various distances up to thirty-two miles; and through about a quarter of a mile I have heard Prof. Bell breathe, laugh, sneeze, cough, and in fact make any sound the human voice can produce. Without explaining the various stages through which his apparatus has passed, it will be sufficient to explain it in its present form. Like Reiss he throws a diaphragm into vibration, but Prof. Bell's diaphragm is a disc of thin iron *a*, which vibrates in front of a soft iron core *b*, attached to the pole of a permanent bar magnet N S (Fig. 2). This core becomes magnetised by the influence of the bar magnet N S, inducing all around it a magnetic field, and attracting the iron diaphragm towards it. Around this core is wound a small coil *c* of No. 38 silk-covered copper wire. One end of this wire is attached to the line wire, the other is connected to the earth. The apparatus at each end is identically similar, so that it becomes alternately transmitter and receiver, first being put to the mouth to receive sounds, and then to the ear to impart them. Now the operation of this apparatus depends upon the simple fact that any motion of the diaphragm *a* alters the condition of the magnet field surrounding the core *b*, and any alteration of the magnet field, that is either its strengthening or weakening, means the induction of a current of electricity in the coil *c*. Moreover, the strength of this induced current depends upon the amplitude of the vibration,



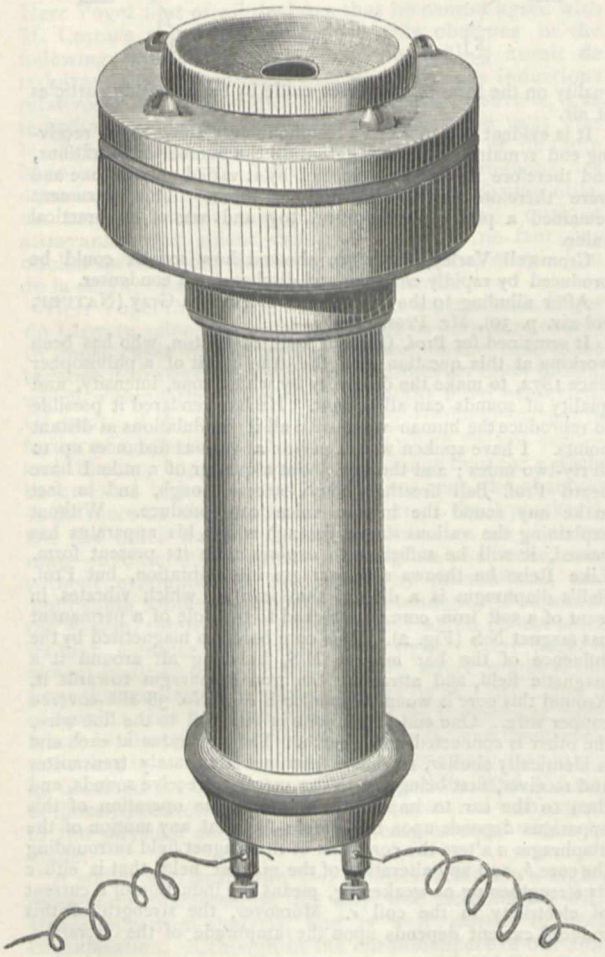
and its form or the rate of vibration. The number of currents sent of course depends upon the number of vibrations of the diaphragm. Now each current induced in the coil *c* passes through the line wire to the coil c^1, and then it alters the magnetisation of the core b^1, increasing or diminishing its attraction for the iron diaphragm a^1. Hence the diaphragm a^1 is vibrated also, and every vibration of the diaphragm *a* must be

[1] Paper read by Mr. W. H. Preece, Memb. Inst. C.E., at the Plymouth Meeting of the British Association. For the sectional cuts we are indebted to *Engineering*.

repeated on the diaphragm *a* with a strength and form that must vary exactly together. Hence, whatever sound produces the vibration of *a* is repeated by a^1, because its vibrations are an exact repetition of those of *a*.

It is quite evident, however, that Bell's telephone is limited in its range. The currents operating it are very weak, and it is so sensitive to currents that when attached to a wire which passes in the neighbourhood of other wires, it is subject to be acted upon by every current that passes through any one of those wires. Hence, on a busy line, it emits sounds that are very like the pattering of hail against a window, and which are so loud as to overpower the effects of the human voice.

Now Mr. T. A. Edison, of New York, has endeavoured to remedy these defects in Bell's by introducing a transmitter which is operated by battery currents, whose strength is made to vary directly with the quality and intensity of the human voice. In



Bell's Articulating Telephone.[1]

carrying out his investigations in this field he has discovered the curious fact that the resistance of plumbago varies in some ratio inversely with the pressure brought to bear upon it. Starting from Reiss's transmitter he simply substitutes for the platinum point (*d*) a small cylinder of plumbago, and he finds that the resistance of this cylinder varies sufficiently with the pressure of the vibration of the diaphragm to cause the currents transmitted by it to vary in form and strength to reproduce all the varieties of the human voice. His receiver also is novel and peculiar. In 1874 he discovered that the friction between a platinum point and moist chemically-prepared paper varied every time a current was passed between the two, so that the rate with which the paper moved was altered at will. Now by attaching to a resonator *a* a spring *b*, whose platinum face *c* rested on the chemically prepared paper *d*, whenever the drum *e* was rotated and currents sent through the paper, the friction between *c* and *a* is so modified that vibrations are produced in the resonator *e*, and these vibrations are an exact reproduction of those given out by the transmitter at the other station.

Edison's telephone, though not in practical use in America, is under trial. In some experiments made with it songs and words were distinctly heard through 12,000 ohms, equal to a distance of 1,000 miles of wire.

Bell's telephone is, however, in practical use in Boston, Providence, and New York. There are several private lines that use it in Boston, and several more are under construction. I tried two of them, and though we succeeded in conversing, the result was not so satisfactory as experiment led one to anticipate. The interferences of working wires will seriously retard the employment of this apparatus, but there is no doubt that scientific inquiry and patient skill will rapidly eliminate all practical defects.

To Prof. Graham Bell must be accorded the full credit of being the first to transmit the human voice to distances beyond the reach of the ear and the eye by means of electric currents.

[1] This instrument was used by Mr. Preece in his experiments (see NATURE, August 23, p 342).

THE BRITISH ASSOCIATION

REPORTS.

Report of the Committee, consisting of the Rev. H. F. Barnes, C. Spence Bate, Esq., H. E. Dresser, Esq. (Secretary), Dr. A. Günther, J. E. Harting, Esq., J. Gwyn Jeffreys, Esq., Prof. Newton, and the Rev. Canon Tristram, appointed for the purpose of inquiring into the possibility of establishing a Close Time for the Protection of Indigenous Animals.—Your Committee begs leave to report that the object for which it was appointed continues to receive a considerable share of public attention, and that during the past year the three Acts of Parliament establishing a close time for certain kinds of birds have attracted so much notice that there is no fear of their falling into neglect.

There is no symptom of the diminution of the interest which the Sea-birds Preservation Act (1869) has always excited; and within the past twelve months application for the extension of the close time has been made, according to the provisions of that Act, by the Justices in Quarter-Sessions of Northumberland, Lancashire, and the North Riding of Yorkshire—facts which sufficiently speak for the general appreciation of the measure.

The Wild Birds Protection Act (1872) is possibly viewed by the public with greater favour than either of the others; but your Committee sees little reason to modify the opinion of it expressed in former reports. Nevertheless a conviction under it, presenting some rather important features, in May last, indicates that it is not so entirely useless as had been thought.

The Wild Fowl Preservation Act (1876) came into operation this year, and at first undoubtedly caused some discontent in many quarters, a warm discussion of its principle and provisions being raised by a portion of the public press. Your Committee, however, has noticed with much satisfaction that virtually no objection was taken to its principle, while the necessity of some enactment of the kind was conceded on almost every side. Furthermore, very nearly the sole cause of complaint lay in regard to the limits of the close time therein imposed, on which point no blame attaches to your Committee. The limits of the close time proposed in the Bill, as draughted by your Committtee, and introduced into Parliament, were, as stated in last year's report, altered in its passage through the House of Commons; the change being such as your Committee then declared did not meet with its approval. Your Committee is therefore in no way responsible for the unseasonableness of the close time which was enacted, and believes that the soundness of its views on the subject is now generally admitted. In confirmation of this belief it may be stated that the Justices in Quarter-Sessions of the counties of Dorset, Norfolk, Kent, Somerset, Southampton, Wigtown, and Essex, have severally made application to the Home Office for such an alteration of the close time as will bring it more or less nearly in accordance with that originally proposed by your Committee.

Another charge was brought against this Act. It was alleged to be imperfect in that it did not expressly prohibit the possession or sale, during the close time, of birds of the kinds professedly protected, which had been imported into this country from abroad. This charge was supported by the dismissal (on the latter ground) by two magistrates of informations laid against certain poultrymen or game-dealers in London, and if it could have been

sustained would undoubtedly have proved the Act to be defective. But the Royal Society for the Prevention of Cruelty to Animals appealed against one of these decisions; and on June 15 judgment was given in the Common Pleas Division of Her Majesty's Court of Appeal against the defendants in the case, thus proving that the legal interpretation of the Act agreed with the intention of its promoters.

Your Committee has satisfaction in finding that the Fisheries (Oysters, Crabs, and Lobsters) Bill passed the House of Commons on August 2, and it has now doubtless become law. It appears curious that no close time had hitherto been provided by the legislature for these important and favourite articles of food.

Having regard to the applications made from time to time to different members of your Committee by various persons interested in seeing the close time principle more widely applied, your Committee respectfully solicits its reappointment.

SECTION A.—Mathematical and Physical.

Prof. S. Haughton gave a summary of the first reduction of the tidal observations made by the recent Arctic expedition. The results arrived at were of great importance, and as far as tidal observations were concerned, the late Arctic expedition was a complete success; they also came in at the right moment for comparison with those made in the *Polaris* expedition. Lieut. Archer had charge of the tidal observations made on board the *Discovery*, and his notes were as complete and valuable as any he had ever examined. The *Discovery* was anchored at Bilhow Harbour; the *Alert* lay off Cape Sheridan, and was in every way less favourably situated for observing the action of the tides. The *Discovery* rose and fell with every tide, while the *Alert*, on the contrary, was surrounded by grounded ice of a formidable kind. Observations were made on board the *Discovery* every hour, instead of once in four hours, as required by the instructions. It was an unprecedented feat that during seven months observations were made every hour, and that there were only six days in the whole course of that time in which he had to interpolate coefficients. The *Alert's* observations required coefficients for fifteen days. The results obtained by Dr. Bessel from the *Polaris* expedition were confirmed by the English expedition, viz., that there was a junction of two important tides in the largest portion of Smith's Sound. The position of the *Discovery* was much nearer to the point of meeting, and this afforded another reason why her observations were more valuable than those of the *Alert*. It seemed that a new type of tide had been discovered, which could not be confounded either with that from Baffin's Bay or that from Behring's Straits, thus confirming Sir George Nares's opinion that Greenland is an island, as this new tide could only have come round from the east coast by a northern route. This stronger tide also presented a feature of great promise in tidal theory, indicating the probability of actual measurable tides occurring every eight hours. Dr. Moss, of the *Alert*, who was present, explained the very different conditions under which the two ships wintered.

Sir William Thomson read a joint paper by himself and Capt. Evans *On the Tides of Port Louis* (*Mauritius*) *and Freemantle* (*Australia*). The investigation had been undertaken in consequence of the recent Government grant for scientific researches. A sum of 200*l.* had been voted from this grant on the urgent representations of Capt. Evans and himself for the purpose of investigating the tides of the southern hemisphere, and making certain definite advances in the investigation of the tides in other parts of the world, particularly in the Mediterranean. The first proceeds of the work done was the present paper. The observations showed that there was a very near approach to equality between the solar diurnal tide and the lunar diurnal tide. The diurnal tide at Liverpool and Freemantle was about the same, but the semi-diurnal tide at Liverpool was about two hundred times as great at Liverpool as at Freemantle. He hoped that as the investigations were continued, they would be able not only to obtain scientific results but to obtain a practical way of giving tidal information in a form which would be useful to sailors—a desideratum that had not yet been obtained. Hitherto the theory of the Government had been that the information given in the Admiralty tide tables was sufficient for the practical purposes of navigation; and it was on that theory that Mr. Lowe, when Chancellor of the Exchequer, refused the application of the British Association for assistance in the matter. The fact was that the Admiralty tables did not give all that was necessary for the purposes of navigation, so that at all events the reason given by Mr. Lowe was a bad one. However the money had now been obtained from the Government grant of 4,000*l.* for scientific purposes; a grant, the working of which would, he hoped, more than fulfil all the aspirations of those who looked forward to it as a great boon to science, likely to produce results beneficial to the whole world.

Prof. G. Carey Foster gave an interesting paper *On the Mode of stating Certain Elementary Facts in Electricity*, and Mr. J. Traill Taylor described a binocular microscope of high power which Capt. Abney stated overcame the many difficulties in the way of obtaining microscopic pictures. Mr. S. P. Thompson exhibited some new optical illusions, which were much appreciated by the section, and also an improved lantern galvanoscope; and Messrs. C. H. Stearn and J. W. Swan exhibited a new form of the Sprengel air-pump. Among the other papers were *An Account of some Recent Advances in the Lunar Theory*, by Prof. J. C. Adams; *On the Eclipse of Agathocles considered in Reply to Prof. Newcomb's Criticism on the Co-efficient of Acceleration of the Moon's Mean Motion*, by Prof. S. Haughton; *On the Lower Limit of the Prismatic Spectrum*, by Lord Rayleigh; *On a New Unit of Light for Photometry*, by Mr. A. Vernon Harcourt; *On a New Form of Apparatus to Illustrate the Interference of Plane Waves*, by Mr. C. J. Woodward; and *On the Physical Properties of Solids and Liquids in Connection with the Earth's Structure*, by Prof. Hennessy. This last paper referred to experiments made by the author on the motion of fluids with a view to determine the conditions of viscidity and friction by which such motions are influenced. The principal results had been communicated to the Royal Irish Academy; the investigation had reference to Hopkins's theory of the great thickness of the earth's crust.

Mr. W. H. Preece gave an account of the telephone (which we give elsewhere), with illustrations, and this excited much interest in the section. On a later day Dr. J. Graham Bell, who arrived at Plymouth during the meeting, gave a series of experiments with the telephone before Sections A and G conjointly to a large audience; it is scarcely necessary to say that the telephone was the chief attraction of the meeting.

The supply of valuable papers in Section A was very good, and the meeting, as far as this section is concerned, was a successful one, though the attendance was not so large as last year at Glasgow. On account of the number of papers it was necessary to divide the section into two parts on Monday and Tuesday, Prof. Cayley and Lord Rayleigh being respectively the chairmen of the sub-sections on these days. On Monday the sub-section was occupied wholly with mathematics. There were papers by Prof. de Haan *On the Variation of the Modulus in Elliptic Integrals*, by Prof. Cayley *On a Suggested Mechanical Integrator for the Calculation of an Integral* $\int (\times dx + \gamma dy)$ *along an Arbitrary Path*, by Mr. J. W. L. Glaisher *On the Values of a Class of Determinants*, and *On the Enumeration of the Primes in Burckhardt's and Dase's Tables*, by Mr. H. M. Jeffery *On Cubic Curves*, and by Sir William Thomson *On Solutions of Laplace's Tidal Equation for Certain Special Types of Oscillation*. Prof. J. C. Adams gave *An Account of his Calculation of the first Sixty-two Bernoulli's Numbers*. Only thirty-one had been previously calculated. Prof. Adams had also calculated the value of the sum of the reciprocals of the first thousand integers to 260 decimals, and thence, by means of the Bernoulli's numbers, the value of Euler's constant also to 260 places.

At the conclusion of the business of the section Sir William Thomson referred to the great loss the Association had sustained by the death of Mr. Gassiot, which took place on the first day of the meeting.

SECTION C.—Geology.

On the Exploration of some Caves in the Limestone Hills in Fermanagh, Ireland, by T. Plunkett.—This paper gave an account of trial explorations begun in the caves in question. They will now be carefully explored by a committee of the Association, aided by a grant from its funds. Large numbers of bones associated with human remains are found in cave-earth under stalagmite. The author also states that "a human jaw was found imbedded in glacial clay and associated with scratched stones." It is evident that the caverns here are of great interest and importance.

On the Origin and Antiquity of the Mounds of Arkansas, U.S., by Prof. J. W. Clarke.—The mounds vary from three to five feet high, and are from fifty to 140 feet in diameter. The author suggests that they were evolved from the simple carn-hillock by a race of men who followed the retreating glaciers.

A Short Sketch of the finding of Silurian Rocks in Teesdale, by W. Gunn, F.G.S.—It has always been believed that no rocks lower than the carboniferous limestone are exposed in Teesdale. The recent work of the Geological Survey has proved that certain peculiar beds at the Cronkley Pencil Mill are not carboniferous, but silurian. Messrs. Gunn and Clough have lately described these beds in a paper read before the Geological Society. The notes submitted to the Association record further discoveries of silurian beds near Widdybank Farm. They probably belong to the Stockdale series of pale slates.

Note on the Correlation of certain Post-Glacial Deposits in West Lancashire, by C. E. De Rance, F.G.S.—This paper described the post-glacial drifts of the Ribble Valley, and compared them with the drifts of the Lancashire Plain. The submerged forest of the coast and the peat of the plains are continuous with the peat of the valley. They contain beech-nuts. The Ribble has excavated its valley in glacial drift to a depth of from 150 to 200 feet; the sea at the same time has cut back the coast, forming a lowland plain on which the forest grew; subsequently the drainage became obstructed and the peat was formed. A subsidence of the land of some seventy feet or more submerged the peat and forest.

On the Influence of the Positions of Land and Sea upon a Shifting of the Axis of the Earth, by A. W. Waters, F.G.S.—The author pointed out how the unequal distribution of land and sea may be an agent in preventing the movements of elevation and depression of the land in one part of the globe, balancing those in another, and further showed how similar movements in various localities would differently affect the pole.

Any movement such as a submarine elevation which displaced water would spread it over the oceanic area, and the effect of this would, with the present configuration, be the same as if about one-twelfth of the weight had been added in the southern hemisphere along 45° 44′ long. E., viz., in a line passing by the entrance of the White Sea over the Caucasus through the middle of Madagascar.

As every submarine movement would create a force acting in this direction there seems reasonable ground for thinking the tendency would be for the shifting of the axis to take place near this line. Dr. Jules Caret considers that the pole must have moved approximately in a line passing through the meridian of 52° long. E., and what is cause, what effect, and how far they react on one another, is fully worthy of examination by any physical geologist.

The shifting caused by any elevation of land near the water or poles is very slight, so that the effect of the water displaced is up to about the fifth degree of latitude as great or greater than that caused directly by the movement of the land. From this it is apparent that near the equator a submarine movement may act on the pole in a contrary direction to that exercised by a similar movement nearer 45° lat. As about one-eleventh of the globe is included between the latitudes 5° N. and 5° S. the effects of the movements here are specially worthy of consideration.

The effects of the drying up of an ancient Caspian Sea was taken as an illustration of the points brought forward. The loss of water of double the area of the Caspian evaporating to a depth of about 200 feet would by the loss of weight of water, shift the pole about 166 feet towards the White Sea, but as this water would be so distributed as to cause additional weight along 45° 44′ long. E. in the southern hemisphere, it would shift the pole still further in the same direction, making a total of about 176 feet. If there were a Caspian Sea in the south along this line then similar phenomena would cause a movement of 156 feet as against 176 feet in the north.

On the Source and Functions of Carbons in the Crust of the Earth, by A. J. Mott.—Plants get their carbon from the air, and as carbon deposits in the earth's crust, from the graphite of the Laurentian to the Lignites of the Tertiary, are believed to be derived generally from plants, the origin of those deposits must be looked for in the source of the atmospheric supply. Calculations based on the reports of the Royal Commission on Coal, and other data, show that the average quantity of unoxidised carbon of vegetable origin in the earth's crust cannot be less, and is probably many times greater, than 3,000,000 tons per square mile of surface. This is 600 times as much as the atmosphere now contains in the form of carbon-dioxide, and if it had been drawn from an atmosphere originally charged with it to this extent, the oxygen liberated in the process would have been twice as much as now exists. As all animal life is destroyed by any considerable change in the constitution of the air; as it was abundant before the coal-formation, and as a great part of the carboniferous deposits are of later date, the theory becomes incredible. We are obliged to conclude that the carbon withdrawn from the air and returned to the ground by plants, has been annually supplied, and the liberated oxygen regularly removed, and the only rational explanation is found in the hypothesis that the oxygen and carbon are reunited; in other words, that carbon equal in quantity to the annual deposit is annually burnt underground.

The objection to this, founded on the small quantity of nitrogen in subterranean gases, is readily shown to be invalid. The annual deposit of carbon, which is a measure of the quantity annually burnt underground, is estimated at three cubic miles; the estimate being based on the annual produce and the known facts concerning its destination.

It is shown that by this process of oxidation and its physical consequences, the heat developed internally is probably equal to the annual loss, and that the earth, therefore, is not cooling. The extent of geological change thus accounted for is also considered, and the quantitative deductions are compared with known facts. It is concluded finally that the carboniferous deposits now existing can only be accounted for on the supposition of previous similar deposits, and consequently that nothing is known at present as to the origin of vegetable life, or concerning any period before it existed on the earth.

On the Occurrence of Pebbles in Carboniferous Shales in Westmoreland, by G. A. Lebour.—This was merely a note of occurrence of rounded and subangular pebbles of quartz or quartzite (which were exhibited) in a bed of carboniferous shale in Angill, Westmoreland. The pebbles were all of the same character, and were probably derived from some of the Lake District rocks and not from veins.

Notes on the Age of the Cheviot Rocks, by G. A. Lebour, F.G.S.—The Cheviot Hills consist of porphyrites, passing into granite and syenite; ashes and doleritic rocks also occur. These igneous rocks are newer than the silurians, on the denuded upturned edges of which they rest; they are older than the lowest carboniferous (or tuedian) beds of Northumberland, for these rocks are in part composed of porphyrite pebbles. This evidence fixes the age of the mass of the Cheviots as Devonian, or thereabouts. The author showed that on the south side of the Cheviots, near the head of Redewater, there are vesicular dolerites breaking through the tuedian beds; elsewhere (as in Punchestown Burn) there are doleritic breccias containing fragments of porphyritic and lower carboniferous rocks. We thus have evidence, in the Cheviot range, of rocks of probably Devonian, tuedian, and Bernician age, belonging to the same eruptive centre.

SECTION D.—BIOLOGY.

Department of Anatomy and Physiology.

ADDRESS TO THE DEPARTMENT BY PROF. MACALISTER, VICE-PRESIDENT.

AFTER referring to the strength and independence now possessed by the sciences of animal morphology and physiology, Prof. MacAlister referred to recent important advances in embryology. Among researches respecting the early formation and primary developmental changes in the egg, he alluded to those of E. van Beneden, Bütschli, Ihering, and Oscar Hertwig, classified under three heads. (1) What is the method whereby the stimulus to development directly operates on the egg; (2) What becomes of the germinal vesicle; and (3) In what manner and from what source the directive corpuscles arise, and what function do they serve in the animal economy. The next subject dealt with was the history of the primitive groove of the fertilised egg, as discovered by Dursy, Schäfer, Balfour, and Rauber. Prof. MacAlister could not but believe that a change had taken place in the position of the embryo on the surface of the germinal disc in the evolution of vertebrates, and that the primitive groove was the heirloom of this ancestral change. Coming then to the question of the origin of vertebrate limbs, the address referred to the researches of Balfour and others, showing that the limbs are

the remains of continuous lateral fins. The professor then went on to say :—

The vertebrate animal is primarily composed of a chain of similar segments, and there is no *à priori* reason in morphology why any one metamere should not bear limbs as well as any other. Nay, from the analogy of chætopod worms we might expect that—as in these each zonite usually bears two pairs of parapodia or stumpy foot-processes—so in similarly derived and similarly segmented forms there might be at least traces of a similar multiplication of appendages.

In effect we really do find a somewhat parallel series in the metameres of fishes, for, as Mr. Balfour has shown, the mediodorsal fin comes into existence precisely in the same manner as the lateral fin ridge, and being a double structure, as we learn, both in its specialised form and even in the structure of the cartilaginous precursor of the interspinous bones, it may reasonably be supposed to represent structures homologous with the system of notopodia in a laterally-compressed worm, fused together, while the paired fins may be regarded as the neuropodia, separated by the visceral cavity, and which, in the degraded and compressed metameres behind the visceral cavity, also coalesce, forming another primary ridge, that of the anal and caudal fin.

In relation to the primary source of origin and method of derivation of limbs we have to account for two separate factors, the limb-girdle and the limb-rays ; with regard to the former I can now only refer to the hypothesis of Gegenbaur and Dohrn, that the limb-girdles represent modifications of the visceral arches, and I pass this by with two comments :—1. That the visceral arches are themselves to a certain extent specialised, and consequently it would be better to state the hypothesis thus, that the limb-girdles and visceral arches are specialisations of corresponding paraxial structures in different metameres. 2. In the light of the evident fundamental complexity of the limb-girdles it seems a simpler explanation of phenomena to regard each girdle as made up of the arches of several, probably three or more, metameres fused, rather than as subdivisions of a single arch.

As to the primary nature of the limb-ray, Professors Huxley and Gegenbaur have taught us in their recent reconstruction of the theory of the Archipterygium, that the primitive limb was constructed somewhat like the limb-ray of Ceratodus, having a central jointed axis from which diverge fore and aft lateral processes, or, to use the elegant nomenclature of Prof. Huxley, the primitive vertebrate limb consisted of a column of mesomeres, to each of which a lateral pre- and post-axial paramere was articulated.

But even this form, though doubtless the stock from which the limbs of all vertebrates above the Dipnoi have sprung, is regarded, and with reason, by Gegenbaur as a derivative one, formed by the coalescence of a still more archaic arrangement of rays appended to the paraxial arches referred to above. It is possible that the primary fusion may have taken such a form as that which Gegenbaur represented in his original Archipterygium with more than one cartilage appended to the girdle, a form of which the arrangement in the dogfish and angel-shark may be representative, and these, by a still farther concentration, attended with an exaltation of the mesopterygium and a displacement of the propterygium as in Hexanchus, or of the pro- and metapterygium as in Cestracion, may thus reach the elongated form of the limb in Dipnoi. It seems obvious that this fish Ceratodus, though singularly generalised, has arisen from a point in the vertebrate stem above the starting-point of the elasmobranchs.

Whether this has been the case or no, whether the elasmobranch has been derived from an earlier condition than the dipnoan progenitor or no, the researches of Prof. Huxley have made it plain that it is from the meso-, and not from the metapterygium that the single basal ray bone of the higher vertebrates has arisen.

A curious question will naturally occur to any one considering the genesis of limbs, What is the reason that in vertebrate animals the number of limbs is limited, and apparently has been always limited, to four? and as we have seen that there is an ontological possibility that each of these contains elements from several metameres, there is no morphological reason, and therefore must be some mechanical cause for this limitation. Were the primitive vertebrates terrestrial we could understand that the tetrapod has a mechanical advantage over the tripod or any condition with an inferior number of limbs, both statically from the indeterminateness of the strain on each support in the four-legged form, and in progression, from the easily understood conditions of stability of equilibrium in walking ; while the tetrapod excels the hexapod or millipede not only because, by a reduction in number, the amount of nutrition required for the use of the limbs is minimised, but it is absolutely demonstrable that the facility of rotation is increased by the reduction of the limbs to the lowest number consistent with other conditions of utility. In connection with this point Prof. Haughton has made some curious observations, the results of which I hope we shall have laid before us in this department during our present meeting.

But the earliest vertebrates were aquatic, and yet even here we find the four-fold division of these actival appendages. These primitive forms differed from worms, in the greater amount of fusion of their metameres, which at an early period had ceased to give to these animals an externally jointed appearance, so we may learn from Amphioxus, which has branched from the vertebrate stem long before most of the secondary characters, which are constant throughout the rest of the vertebrates, had been foreshadowed. Being thus more consolidated than worms, and moving, as they would necessarily do, more as a unit and less as a chain, the advantages of the mode of propulsion by a tail, over swimming by means of the continuous lateral fin of united parapodia, would be increasingly manifest with increasing somatic rigidity. Hence, naturally, the parapodia of the hinder somites would coalesce to form a tail as they have done in fishes, and the appendages placed farther forward would undergo retrogression unless some function could be found for them which would make their retention an advantage in the economy. In the long worm-like forms like lampreys, such a retrogression has absolutely taken place, as in fishes of this form the use of lateral fins is reduced to a minimum ; hence in the elongated form of ordinary fishes, like eels, band fishes, and blennies, the lateral fins become rudimental or varied. But these organs are of obvious use in giving a capacity to alter the plane of motion, a power which is necessary for most fishes, as they only act in elevation and depression but in lateral rotation, as any one can verify for himself by watching fishes in an aquarium. In order to accommodate these united lateral appendages most conveniently to the sinuous curves into which the body of a fish is thrown in swimming, and to diminish the surface of resistance to the water, the parapodia have divided themselves into two groups, leaving the centre of the body, where the cephalic and caudal curves meet during progression, free from lateral appendages.

The address concluded by a brief notice of work in human anatomy. It was remarked that much remained to be done in details even in this well-wrought department. We had not available correct and broadly based statements regarding the average conditions of the variable parts of the human body. Considering that something like six hundred bodies were annually dissected in Great Britain and Ireland, such a basis ought to be easily attainable. In such work Prof. Wenzel Grüber, of St. Petersburg, the prince of descriptive anatomists, was laborious and indefatigable. Yet still much remained to be done to make human anatomy a really scientific study, a practical application of morphological principles.

One of the features of this department was Prof. Haughton's discourse on the best possible number of limbs for an animal. The criterion was the most economical expenditure of force, according to mathematical principles. With regard to land animals, it was shown that the three-limbed vertebrate is superior to two and one-limbed forms, being perfectly stable when resting on the limbs. The four-limbed vertebrate, however, was able to preserve perfect stability on any three of its limbs, while using the fourth for offence. There was for the most part no advantage in having five or a greater number of limbs, the cost of feeding the extra limb outweighing the advantage of possessing it. Arboreal animals developed the tail as a fifth limb because of its special advantage in the medium in which they lived. Man gave up the superior stability of having four limbs for support in exchange for two adapted to higher uses, and in correlation with his brain-power. In discussing the limbs of aquatic animals, Prof. Haughton showed how advantage in the use of force and in directing motion was gained by concentration of motor power and limitation of the number of limbs. The three-limbed and one-limbed swimmers had advantages over all others, and odd-limbed forms over even-limbed. In many respects the three-limbed swimmers were superior to the one-limbed, but the latter had the valuable quality of being able to apply a maximum force in one direction, and so escape from their enemies. Prof. Haughton indicated fishes [as really pos-

sessing one principal limb in the tail, the fins being only capable of exerting a very slight force when compared with the tail.

The Rev. W. H. Dallinger described some of the processes and results of his investigations into the life-history of the simplest organisms. Among the points especially dwelt upon were the development of four out of two flagella in his calycine monad after fission; the determination of the diameter of the flagellum of *Bacterium termo* to be the two hundred and ten-thousandth of an inch; and special contributions to the spontaneous generation question. Although the life-histories of the forms examined were perfectly definite and distinct, yet the result of his investigations was to give a conviction of the truth of Darwinian principles among simple forms at any rate. He mentioned as a contribution to physiology the discovery that so highly organised an Infusorian as Paramecium could live for a long period in Cohn's (inorganic) solution. An important series of experiments had been conducted with regard to the extent of the adaptability of monads to changed conditions of temperature. It had been found that they could, by gradual increments, be raised from a temperature of 45° to one of 125°, and live and multiply perfectly; but a sudden transition of a much smaller extent was immediately fatal, as was also a sudden fall of temperature. Another series of inquiries showed that it took much longer to produce a modification in the ovum or germ than in the adult.

Prof. Rolleston, in a paper *On the Vascular Supply of the Brain*, ascribed right-handedness to the greater vascularity of the left side of the brain. He further speculated on the probable entire disappearance of the occipital lobe of the brain on account of its deficient relative supply of blood. Prof. Allen Thomson called attention to a remarkable series of photographs, many applicable to the stereoscope, representing the blood supply of various parts of the system. They were executed under the superintendence of Prof. Dantscher, of Innsbruck, from preparations made by himself. Dr. W. H. Pearse read a paper *On the Geography of Consumption in Devonshire*, claiming to demonstrate that the wildest moorland districts had the lowest death-rate from that disease. While England and Wales showed a rate for consumption of 2·47 per 1,000, the rate for western Dartmoor was 0·37, and for the west of Exmoor 0·45. This was notwithstanding the great rainfall.

Mr. G. T. Bettany gave a summary of the conclusions as to the structure and interpretation of the vertebrate skull, contained in the work on the Morphology of the Skull, just published by Prof. Parker and himself. The nature of the trabeculæ and the segmental relations of the skull were especially dwelt upon. In another paper Mr. Bettany advocated the harmonisation of animal and vegetable physiology, by the use of terms in the same sense in both, referring especially to the term assimilation, now so vaguely and discordantly employed in the two sciences. Among other papers may be mentioned Prof. McKendrick's *On the Physiological Action of the Substitution Compounds of Pyridene and Chinoline*, and Dr. Cunningham's, *On the Muscular and Nervous Systems of several little known Marsupials*. Only a small number of anatomists and physiologists were present, and the paucity of papers in physiology was ascribed to the discouragement and hindrance to experimental research caused by the vivisection controversy.

Department of Anthropology.

No striking novelty was brought forward in connection with the geological evidences of the antiquity of man. Various local discoveries of flint implements were noticed, the occurrence of flints in Cornwall and the Scilly Islands being of especial interest, owing to their distance from the chalk. Mr. John Evans described some palæolithic implements from the valley of the Axe, made of chert from the Blackdown beds, proving that where chalk flints were scarce, other siliceous rocks were utilised by palæolithic men for the same purpose. Mr. Widger's collection of extinct mammalia from Newton Abbot caves, as yet only imperfectly explored, excited much interest. Mr. Laws gave an account of a cave at Tenby containing a rich aggregation of extinct mammalia, and recommended the Welsh coast as a rich hunting-ground for anthropologists. Prof. Rolleston and Col. Lane Fox described their exploration of tumuli at Sigwell in Somersetshire, and near Guildford. The co-existence of different styles of interment among a people was confirmed by these researches. Prof. Rolleston's address *On our Knowledge of the Flora and Fauna of Prehistoric Times* was very attractive. In the course of his remarks on trees he noticed that remains of the ash were found in English but not in Scotch peat; the beech again was absent from Scotch peat. With regard to bees and bee-keeping, he said the only certain fact known in relation to the question where and when hives were introduced, was that in all cases the word for hive was allied to the Latin word for it. He thought honey became important very early, as a source of sugar; especially to people who had neither the sugar-cane nor beet-root. He believed great changes had taken place in British mollusca since prehistoric times. The so-called Roman snail was without doubt a very old and well-established British snail; while a little snail most abundant at present was not known in prehistoric deposits. He thought there were the best grounds for believing the rabbit not to be prehistoric in this country. In an old tumulus Prof. Rolleston had found several handfuls of jawbones of the common water vole, and not far off a large canine of a polecat, which had evidently made its nest in the tumulus and fed its young upon water-rats. These are but a few out of many most interesting facts mentioned in the paper. Mr. Spence Bate's description of the prehistoric remains on Dartmoor, visited by an excursion party, was another subject that attracted much attention.

There were a number of valuable papers on the habits, history, &c., of uncivilised peoples. Miss Buckland's paper *On the Stimulants of Ancient and Modern Savages* showed how in all parts of the world, as soon as agriculture was established, people began to make fermented drinks from the roots or grains cultivated for food. But it further appeared that still earlier stimulants were leaves and roots that when chewed were found to produce exhilaration. With the dawn of civilisation these roots and plants were steeped in water, inducing some fermentation. Later the cereals were used, the roots and plants being still retained for flavour and to produce fermentation. The juice of the grape became employed at a subsequent period still. Mr. Bertram Hartshorne read a valuable paper *On the Ancient People of Ceylon*, giving an account of their history as far as it could be gathered, giving many evidences of retrogression among them. The Rev. S. J. Whitmee, the well-known London Society missionary, gave some account of the Malayo-Polynesians, with abundant proofs of their degradation from a higher social and intellectual level. Among these were the comparatively high social position of the women, the existence of hereditary rank and titles, the tenure of landed property, the systematic division of land, and their poetry. Mr. F. M. Hunter described the peculiarities of Socotra Island. In reference to the Bedouin inhabitants, he said that religion seemed to sit lightly upon them. They only prayed when they had an audience, and even in the very act of prostration they would turn round, join in conversation, and again continue their devotions. The mark of the cross was still used on the head-stones of the graves. Mr. A. Simson's paper *On the Zaparos Indians* contained a great deal of curious information.

Coming to regions nearer home, Dr. Beddoe endeavoured to trace the history and ethnology of the Bulgarians, but confessed that much was still unknown on the subject. Although they spoke Sclavonic they did not appear to be really Sclavs or even Turanian. The original Bulgarians were a tribe from the Volga region, probably connected with the Huns. Dr. Beddoe believed that the present Bulgarians were as much Ugrian as anything; they were evidently prognathous. The Rev. W. S. Lach-Szyrma in discussing the Cornu-Britons, divided them into two classes, those who came there under pressure of Saxon invasions, and those who came as immigrants to the coast districts. He did not believe in any Semitic admixture.

The report of the Anthropometric Committee spoke of the serious difficulties attending its observations in the attainment of uniformity and accuracy. Mr. H. C. Sorby described the several different colouring matters he had derived from human hair, the chief being a black pigment and a reddish-brown substance. Very red hair contained a small quantity of pink-red substance. A noteworthy opinion given by Mr. Sorby was that he did not think it possible that hair could change colour in a single night. Other interesting papers were by Prof. Rolleston *On Artificial Deformations of the Human Head* and *On the Rationale of Brachycephaly and Dolichocephaly*, by Dr. Phené and others. Altogether the department sat on five days, and exhibited much vigour; both papers and discussions were very attractive, although the amount of novelty in regard to primitive man and his relations to geological history was not great.

Department of Zoology and Botany.

In this department the greatest general interest was excited by Mr. McLachlan's paper *On the Colorado Beetle*. He gave a most valuable account of its natural history, and then proceeded

to remark on the panic respecting its introduction into England. He approved of restrictive legislation, but said it was as much needed four or five years ago as now. He believed if the beetle could have been introduced if would have been ere now, not so much among potatoes, which were mostly imported from America for seed, in a very clean state, or through the reception of specimens by scientific men, as in a promiscuous manner in general merchandise, owing to its great abundance on the quays of New York, &c. But there was much reason to expect the beetle could not readily be acclimatised in our moist climate. American animals in general failed to spread in Europe. Moreover, Great Britain possessed many insectivorous birds which had no representatives in the United States.

Prof. McNab read several important papers on botanical subjects. One, *On the Movement of Water in Plants*, gave an account of researches by Professors Pfitzer and Hoehnel, continuing and confirming results arrived at by his own investigations. Prof. McNab also brought forward a revised classification of plants, in which he adopted the term Order for the larger groups sometimes called cohorts, and in which the apetalæ were distributed among the petaloid orders to which they are allied. He further gave a synopsis of the present knowledge of fossil flowering plants, showing that Haeckel's postulates as to the evolution and period of first appearance of flowering plants were already shown to be false by new discoveries. It appeared, on the whole, that the gamopetalous forms arose later than the dialypetalæ. Prof. McNab inclined to the opinion that while the monocotyledons were monophyletic, or arose through one line of descent, the dicotyledons were polyphyletic, or derived from several main stocks.

Other papers of interest on botany were by Prof. Dickson, *On the Structure of the Pitcher of Cephalotus*, and by Mr. A. S. Watson, *On Structural Characters in Relation to Habitat in Plants*.

Prof. Rolleston described several features of interest in the zoology of New Guinea, especially the new Echidna, of which he had received a specimen. He detailed the evidences of the former connection by land between New Guinea and Australia, and accounted for the divergence between the vegetation of the two by influences due to the high mountains of New Guinea and the great barren plains of Australia. Mr. W. Ackroyd read a paper *On the Colours of Animals*. A contribution was read from Dr. Otto Finsch, giving the results of the North German Exploring Expedition to Western Siberia. Dr. G. Bennett, from Australia, gave an interesting account of the habits of the pearly Nautilus.

SECTION E.—GEOGRAPHY.

IN this Section, presided over by Admiral Sir Erasmus Ommanney, the president's address consisted of a *résumé* of geographical discovery during the past forty years. Among the papers read none were of special interest.

Major Wilson read a paper by Lieut. Kitchener, R.E., *Report of the Line of Levels from the Mediterranean to the Sea of Galilee*. The levelling commenced in June, 1875, but was soon interrupted by local circumstances. It was resumed in March, 1877, and carried to a successful conclusion by Lieut. Kitchener. There had, as yet, however, been no opportunity of applying corrections. The result of the work showed the depression of the Sea of Galilee to be 682·544 feet. Fortunately they had a perfectly calm day for securing the sea-level. The sea left a clearly-defined white mark at its highest part; the depression shown by Kitchener's observations was some forty or fifty feet greater than had been generally supposed. The depression of the Dead Sea was 1,292 feet, which gave to the Jordan a fall of a little over 600 feet; this fall was nearly even throughout, although there were one or two rapids in its course. The deepest part of the Jordan Valley would be 1,300 feet below the level of the Mediterranean.

Commander Cameron read a paper *On the Proposed Stations in Central Africa, as Bases for Future Exploration*. He thought the best means for the exploration of the continent would be the establishment of trading societies after the fashion of the East Indian and Hudson's Bay Companies, but the spirit of the age was against the granting of sovereign powers to commercial companies. That being so, he considered a system of central stations, placed at intervals of from 200 to 250 miles distant, the best available. The new stations should be placed under the charge of a consul or a vice-consul, or of consular agents, but if the British Government hesitated to undertake the responsibility, the Seyyid of Zanzibar should be asked to accept it, and he believed most of the traders and shyas would recognise the authority of his highness. The stations might be turned to account, not only for the purpose of map-making, but of ascertaining the commercial value of the surrounding districts, obtaining meteorological observations and botanical and zoological collections, accustoming the neighbouring populations to the nature and advantages of civilised rule, systematically extirpating the slave trade, and diverting the traffic now employed in this infamous trade to the development of the enormous national wealth of the continent. In concluding, Commander Cameron made an appeal on behalf of the British Society for African Exploration. He warned his audience that unless Britain speedily bestirred itself it would lose the pre-eminence it long enjoyed among the countries of Europe. At the call of its sovereign the little kingdom of Belgium had contributed 12,000*l.* for the fitting out of an expedition. Portugal had contributed 20,000*l.*, and he hoped the British public would not fail to do their duty as respects the opening up to civilisation of Africa. The more rapidly the light of civilisation is introduced into the continent the more rapidly would the slave trade and domestic slavery die away and become a thing of the past.

A paper by Mr. W. H. Tietkens, *On the Latest Exploring Expedition across Australia*, was read by Mr. Bates. It described the journey made in 1875 by Mr. Ernest Giles, accompanied by the author of the paper and by Mr. Young, from the settlements of South Australia to those of Western Australia. The result of the journey was the conclusion that the occupation of some portions of the country cannot be long delayed, being well adapted for wool growing, but the writer confirmed the opinion expressed by other travellers that the region between lat. 21° and 30°, and long. 123° and 132°, can never be colonised, and that any white men settling in it would become like the wandering nomads now inhabiting it. The expedition was most adventurous owing to the attacks made upon it by some of the natives, and also to the difficulties arising from scarcity of water, which, at one time, threatened to terminate the career of the travellers.

Mr. Trelawny Saunders called in question the conclusions come to by the author of the paper as to the future of Australia, and said such a future would be a serious matter for Plymouth, which was one of the great ports of emigration to Australia. He placed against this opinion the authority of Mr. Landsborough, who had recently described the great physical changes taking place in the Australian continent, in consequence of the occupation of it by our countrymen. Trees were growing where none were previously to be seen, the natives being prevented from burning the long grass for the purpose of getting game. The growth of forests would cause a greater rainfall, and lead to the improvement of the productive qualities of the country.

Col. Godwin-Austen read a paper *On the Course of the Brahmaputra or Sanpu*. The author's argument, founded on researches and surveys in Assam, was that the true outlet of this great river was by the Sukushiri, and not, as was generally supposed, by the Deipong.

THE FRENCH ASSOCIATION AT HAVRE

HAVRE, *August* 30

THE final meeting took place this afternoon at 2 o'clock, under the presidency of M. Broca.

Montpellier has been selected as the place of meeting for 1879. The University of Montpellier has been for centuries a rival to Paris, and even now is bold enough to compete with its formidable rival. Montpellier is also notable as the birthplace of Auguste Comte, the founder of Positivism. A number of scientific gentlemen have subscribed a large sum to receive the Association in 1879; the General and Municipal Councils will also vote a large sum.

It has been suggested by some influential members that the meeting of 1880 should be held in Algeria. But the vote will not be taken till next year at Paris. The year 1880 is the fiftieth anniversary of the conquest of Algeria. There are at the present time very few scientific institutions in the colony. Should the choice be made, the Algiers Academy would probably be then transformed into a University for Algeria.

The Association, at the close of the Havre meeting, has voted

an exceedingly limited number of recommendations to the Government. One of them relates to the organisation of the meteorological service. The Association directs the attention of the Government to the inferiority of French meteorology, and urges the Government to establish an official investigation into its working. All efforts to take the Service des Avertissements out of the hands of the observatory have been defeated. The proposed reform does not aim at diminishing the influence of M. Leverrier on the service he has created in France.

A request is to be sent to the Government to endow the Geological Society of Normandy with the privileges of an institution of public interest, which means to grant it a charter and incorporate it. It is expected that the admirable geological exhibitions collected through M. Lennier's exertions will remain permanent, and become a fair specimen of regional geology. A number of exhibitors have consented either to give their objects or to lend them until similar objects can be procured in their stead. M. Lennier, whose exertions have been indefatigable, is the director and founder of the Havre Aquarium, which is a model institution, not for the variety of species, but for the number of objects and the health of the animals.

The several industrial establishments at Havre were opened for public inspection, as well as the Government buildings. The most interesting object was a fog trumpet of British make. The steam engine working it has a power of three horses. It is calculated to compress about 800 litres of air at a pressure of little more than two atmospheres in two tanks put into communication by a large tube. One of these tanks is in communication with the pump, and the other with the trumpet. The latter is closed by a self-acting valve, which opens once every forty-eight seconds, and during seven seconds gives a voluminous sound in *la* of the diapason.

The last excursion (to Rouen) was more successful than the first. The *Frigorifique* had been sent from Havre to Rouen in order to increase the attraction, and was visited by many of the excursionists.

The number of members of the Havre meeting was not more than 600 altogether. The foreign members numbered about forty, upwards of twenty being Englishmen. Very few ladies attended the proceedings. No final banquet took place, owing probably to the fear of some political discussion disturbing an assembly which ought to be devoted entirely to science.

There is only a single scientific society in Havre which, in spite of its ambitious title (Société d'Etudes diverses) has only sixty members out of a population of 85,000, including more than fifty millionaires. The society meets regularly and publishes yearly a handsome volume. It has been decided to establish a local society of commercial geography, and a local committee to collect meteorological observations taken on board the transatlantic steamers.

If we consider the work done in certain sections the Havre meeting has not been a failure ; but it was altogether a sectional meeting from the inaugural speech of President Broca to the two or three lectures which were delivered in the theatre. We are confident that M. Fremy will spare no pains to render the Paris meeting next year a success and as far as possible international. He will endeavour to get the presidents of sections each to deliver an inaugural address. It is intended to establish a temporary daily newspaper to publish at full length the reports of sectional proceedings, &c.

In the Section of Meteorology the principal business was the vote of the requisition sent to the Government, which will probably induce the Ministry to increase the grant to French meteorology. The majority of the section are in favour of the establishment of a central meteorological institute to investigate large meteorological problems and centralise all meteorological services except weather previsions. A resolution was proposed by Dr. Janssen, urging transatlantic companies to take meteorological observations on board ; another resolution asked M. Giffard to organise a meteorological observatory on board his captive balloon, during the exhibition of 1878. Mr. James Glaisher gave an address on the result of his thirty scientific ascents, and the experiments made in the Ashburnham captive balloon. His address was well received, and he was invited to sit with the bureau. M. Alluard, the Director of the Puy-de-Dôme Observatory, engaged to establish intermediate stations on the flanks of the mountain, and to keep observations during the time when the monster captive balloon is making its ascents. This proposal will be communicated to Gen. Nansouty, Director of the Pic-du-Midi Observatory. A resolution was voted protesting against the delays in the construction of a telegraph line from Pic-du-Midi to Bagnères, for the purpose of sending regular observations during the time when the observatory is cut off by snow from all communication with the world below.

M. Alluard presented to the section diagrams of comparative barometric measures taken on the summit of the Puy-de-Dôme and at Clermont-Ferrand during storms. This shows clearly that the law of pressure varies in inverse ratio, diminishing on the top of the mountains when increasing at Clermont, and *vice versa*. It shows evidently that storms are produced, not by a single wind, but by a conflict of several winds at a certain distance from the earth.

In the Geological Section a large proportion of the papers were on various points connected with the geology of Normandy, one of the most important being a paper by M. Morière on the presence of the liassic stage in the department of Orne and on the fossils he has collected during many years investigation into the geology of the region. In this section, also, M. Pomel read a long paper to prove that M. Roudaire's project of an inland sea in Algeria, of which we recently gave details, is impossible M. Pomel maintains that the level of the Chotts is too high, and that if by any process they could be filled, the water would very soon find its way back to the Mediterranean. Another paper of some importance was by MM. de Tromelin and Grasset, being a "Summary Study of the Palæozoic Fauna of Lower Languedoc and the Pyrenees," for the purpose of comparing the primary formations of the South with those of the North-West of France. M. Jannettaz gave an account of his observations on the propagation of heat in schistose rocks and in crystals. From his experiments he concludes that heat is transmitted more readily along the planes of cleavage of crystals and along the plane of schistosity of slates, gneiss, crystalline or agillaceous schists, than along the direction perpendicular to these planes. He thinks we may thus explain, to a great extent, the variation observed in the increase of temperature with depth in different parts of the globe.

In the Botanical Section M. Corenwinder continued his account of his investigations on the Functions of Leaves. After twenty-five years' work M. Corenwinder thus sums up the results he has obtained :—The leaves of vegetables in their relations to the atmospheric air are the seat of two distinct functions. By their protoplasm they absorb oxygen and constantly exhale carbonic acid. By their chlorophyll, they inspire, on the contrary, during the day only, carbonic acid, and expire oxygen. In their early stage the protoplasm predominates ; chlorophyll is not abundant. Hence the respiratory function predominates during all that period over the chlorophyllian function, and consequently leaves exhale carbonic acid without interruption. In proportion as leaves grow the colourless protoplasm diminishes and the chlorophyll increases ; thus the capacity of emitting carbonic acid rapidly decreases, and soon they exhale, during the day, nothing but oxygen gas. Henceforth it is only by shutting off or diminishing the light, when the action of the chlorophyll is diminished or suspended, that the effect of respiration becomes more or less sensible. There is then among living beings only one kind of respiration. The part played by chlorophyll is of a different order ; it is an act of assimilation which has nothing in common with the preceding. M. Corenwinder hopes that henceforth it will cease to be taught that plants are provided with two respirations, one for the day and the other for the night.

NOTES

We are informed by a cable telegram from a New York correspondent that Prof. O. C. Marsh, the eminent palæontologist, has been elected president of next year's meeting of the American Association for the Advancement of Science, which has just concluded its Nashville session. We have received the *Proceedings* of the last year's meeting at Buffalo.

The Aquarium Winter Garden at Tynemouth, near Newcastle, is rapidly approaching completion. The building occupies a commanding position on the Long Sands between the town of Tynemouth and the little fishing village of Cullercoats. The entire basement is devoted to the Aquarium with its reservoirs and pumping machinery, and the show tanks, of which there will be both a sea and a fresh-water series, will contain

upwards of 140,000 gallons of water. The plan adopted is the circulation system, which has proved so successful in the maintenance of aquatic life at the Crystal Palace, Naples, and elsewhere. Special arrangements are being made for the culture of salmon and trout, and in conjunction with the Aquarium, but out of doors there will be an enormous seal-pond, into which a supply of sea-water will be pumped direct when required. Mr. E. Howard Birchall has been appointed curator.

MR. ALEXANDER BUCHAN, the well-known secretary to the Scottish Meteorological Society, has been sent to Upsala as representative of the Royal Society of Edinburgh, at the celebration of the 400th anniversary of that University.

THE autumn meeting of the Institute of Naval Architects in Glasgow was brought to a conclusion last Thursday, and seems to have been altogether successful. A large number of papers were read and discussion raised on the technical subjects with which the Institute deals, and much of the time was devoted to visiting several of the most important Clyde establishments. The next autumn meeting of the Institute will probably be at Newcastle-on-Tyne.

ON August 29 the Dorset Field Club met at the romantic spot of Lulworth Cove. One section gave themselves to the geology of the district in which the "Purbecks" are so finely exhibited. After some opening remarks by Mr. Mansell Pleydell, the president of the Society, Mr. Damon, F.G.S., gave an address bearing on the geology of the cove and neighbouring strata, followed by Prof. Buckman. Other sections directed their attention to entomology, botany, &c.

A SUMMER school of practical mining for the instruction of the student in the details of miner's work has recently been added to the curriculum of the School of Mines of Columbia College, U.S. This summer school has been put in the charge of Henry S. Munroe, a former graduate of the school, who was recently elected by the trustees to the position of Adjunct Professor. It is proposed that the students of the school shall visit mines in different parts of the country worked for coal, iron, copper, lead, precious metals, &c., and spend a month or six weeks at each, making a careful and detailed study of the mine, and actually engaging, under the instruction of skilled miners, in all the details of mine work. The first experiment was made this summer at the mines of Coxe, Bros., and Co., Drifton, Pa., and with very remarkable success. A dozen students, volunteers from the class of '78, made a stay there of five weeks from July 2. Half of the students worked in the morning and the other half in the afternoon, one squad at a time with each miner. The times of going and coming to and from work were so arranged that each student spent from four to four and a-half hours in the mine each day. On coming out of the mine each squad was required to make a written report of the work done, with sketches showing the location, direction, depth, &c., of each shot fired, and the effect produced. While in the mine they assisted the miner to load his car, thereby learning readily to distinguish "slate" and "bony" from good coal, even in the uncertain light afforded by their mine lamps. They were also instructed in the use of the drill and pick, boring themselves the blast holes, judging the quantity of powder required, making up the cartridge, tamping, and firing the shot. After the students had spent in this way about twenty days at different kinds of work underground and in the "breaker," subjects for more detailed study and investigation were assigned them. Each student, having chosen his theme, spent the remainder of his time in collecting material for a memoir. The experiment has, in fact, been in every way a success.

AT the meeting of the Royal Society of New South Wales on June 6, Mr. Russell exhibited an improved form of bichromate battery, by which the current of electricity generated is kept quite constant so long as it may be required. This is accomplished by allowing the bichromate solution to drop in slowly, and flow out at the same rate through a pipe which commences at the bottom of the cell and passes through the side at three-quarters of an inch from the top. When the supply tap is turned, the solution collects in the cell until it rises to the level of the pipe, and it then begins to pass out as fast as it comes in. As the bichromate solution passes down the cell its active properties are made use of, and when it reaches the bottom it is waste, and passes out as described. In use it is found that the zinc and solution are more economically used than in the ordinary bichromate cell. The Society held its annual *conversazione* on May 16. About 600 members and their friends were present. Amongst the exhibits were some very rare and choice plants from New Guinea. Mr. Russell, Government Astronomer, was most successful in showing large smoke vortex rings, which blew out a spirit-lamp flame at a distance of fifty feet.

THE Report of the Leicester Literary and Philosophical Society speaks satisfactorily of its progress. A year ago the society took possession of new buildings, and its main work as a society is carried on by its six sections, which include the various departments of science. The number of members now exceeds 300.

WE have received a very useful Russian *brochure* by M. Bogdanoff, "A Review of Expeditions and Natural History Researches made in the Aralo-Caspian Region from 1720 to 1874," being the first fascicule of a large work. In 1874 Prof. Barbot-de-Marny, geologist, with MM. Bogdanoff and Butléroff, jun., zoologists, explored vast tracts of land between the Caspian and the Aral lake, and MM. Grimm and Alénitzin studied the fauna of these two interior seas. Preliminary reports by the explorers have been already published. M. Bogandoff's paper is intended to give, in a very condensed form (52 pages), an introductory review of scientific work in the Aralo-Caspian region during the 150 years before this expedition. It has been visited and explored by no fewer than sixty men of science. Yet the great problems so vividly and skilfully developed and discussed by Humboldt and his followers—the problems of the former extension of the Caspian, of its junction with the Aral and the Balkash, of the geological time when this immense interior basin existed, of the causes which determined its drying up and the change of bed of the Amu-darya—all remain as open a field of inquiry as ever. We find immense gaps in every department even in the description of the country. The hydrology of the Caspian and Aral is sufficiently well known, but the third great basin, the Balkash, and a great number of smaller lakes remain unexplored. The flora is well known, and the great work of Borshioff sums up numerous local accounts, but the zoology is very unequally advanced; the lower organisms and the amphibiæ are all but totally unknown. The insects, and still more the vertebrates, are well described, but even in this branch the fishes have been neglected. Prof. Kessler finds many unknown forms even among those of the Caspian, which have been best explored, and the fishes of the Aral and Balkash promise to present plenty of most interesting new forms and varieties. As to the much-debated question of the former bed of the Amu-darya, M. Bogdanoff points out that this remarkable geological phenomenon remains unexplained. We must hope that the labours of the Aralo-Caspian expedition, and of other explorers in the same region, will finally throw some light on the problems involved in the study of this depression of the old continent.

IN an interesting pamphlet on "The Work of Mechanics' Institutes in our Towns," by Mr. Swire Smith, the author contends that the work of mechanics' institutes in towns consists on the one hand in supplying the deficiencies of the day school,

and directing its education into useful channels; on the other in giving general information and providing recreation and amusements of a social character. He endeavours to point out the improved prospects of mechanics' institutes in the future, and appeals to public spirit for the erection in many towns of more appropriate buildings. He suggests the propriety of establishing day schools as nurseries for the rudimentary teaching of science, and refers to the help from national and other sources that may be obtained by taking up this work systematically. He urges the vast importance of scientific knowledge for our artisans, the equal importance of a training for girls in the matters appertaining to their welfare, and points out the great need for making classes more attractive. He speaks of the value of penny banks for promoting thrift. Finally, he tries to show the necessity of making the institute more popular as a place of resort for the people of our towns, as a safeguard against pernicious attractions, and for the supply of information, entertainment, and recreation.

In connection with Capt. Howgate's scheme of Polar exploration, the *Florence*, under Capt. Tyson, of *Polaris* fame, left New London on August 16, *viâ* Cumberland Coast, for whaling purposes. It will then proceed to Greenland to engage Esquimaux families. This pioneer party will meet at Disco, next August, the main Polar expedition under Capt. Howgate. The expedition, it is expected, will be fitted out by the United States Government as soon as Congress meets, and will have voted the required subsidies for establishing a scientific colony at Lady Franklin Bay. The use of balloons having been suggested, Capt. Howgate has written the following letter to M. W. de Fonvielle, who has offered to become a member of the scientific staff of the expedition. It is dated from the "War Department, Office of the Chief Signal Officer, Washington, D.C., August 16, 1877."—"Your valued favour of the 16th June, addressed to Capt. Tyson, was forwarded to me for reply. This reply has been necessarily delayed by the amount of work thrown upon me during the fitting out of the *Florence*. But I avail myself of this first opportunity to say that, should Congress, as I hope, legislate favourably for the proposed Arctic colony at its next session, it is my intention to try the value of balloons as an agent of exploration; and your services, so courteously offered, will be thankfully accepted. Your reputation as a man of letters and science is too well known to render such references as you allude to necessary."

The additions to the Zoological Society's Gardens during the past week include a Barbary Ape (*Macacus inuus*) from North Africa, presented by Mr. E. Barclay; a White-fronted Capuchin (*Cebus albifrons*) from South America, presented by Mr. Shipman; a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Mrs. Rintoul; a Leadbeater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by the Rev. S. J. Whitmee, C.M.Z.S.; an American Tantalus (*Tantalus loculator*), two Prince Albert's Curassows (*Crax alberti*), three Black-faced Spider Monkeys (*Ateles ater*) from U.S. Columbia, a Kinkajou (*Cercoleptes caudivolvulus*) from Honduras, deposited; a Tamandua Ant-eater (*Tamandua tetradactyla*), an American Darter (*Plotus anhinga*), an Ashy-headed Gull (*Larus cirrocephalus*) from South America, a Brazilian Motmot (*Momotus brasiliensis*) from Brazil, a Sorry Thrush (*Turdus tristris*) from Mexico, purchased.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, August 27.—M. Fizeau in the chair.—The following papers were read:—Note on M. Lavy's catalogue of stars of longitude and lunar culmination, by M. Faye. This catalogue of 521 stars is recommended as a work of precision which should be of real service.—Two general laws of geometric curves of order and class, m and n, by M. Chasles.—On the relation which should exist between the diameter of cores of iron and the thickness of their magnetising helix, by M. Du Moncel. It is shown from experiment that there is advantage in winding electro-magnets so that the thickness of the coil-layers is equal to the diameter of the cores; and for this law to be well applied, the diameter of the cores should naturally be proportioned to the electric intensity which is to act on them, and chosen so that this intensity develop in them a quantity of magnetism pretty near the point of saturation.—On an example of reduction of Abelian integrals with elliptic functions (continued), by Prof. Cayley.—Observations of the planets 173 and 174, and remarks on the discovery of this latter planet, by M. Stephan. On August 8 Mr. Watson observed a star of the tenth magnitude not marked on his maps, but it was not till the 16th that it was recognised as a planet. M. Borrelly first perceived the star on the 10th, and next day its planetary character was ascertained; priority is thus claimed for M. Borrelly.—Provisional geographical map of the planet Mars, by M. Flammarion. In this work (commenced in 1863) the author has aimed at giving a general *ensemble* of observations from the beginning.—Observations on a recent note of M. Du Moncel, on the best conditions of employment of galvanometers, by M. Raynaud.—Reply to a recent communication of M. Angot, on the evaporation in the region of the Algerian chotts, by M. Roudaire.—On the termination of the nerves in the electric apparatus of the torpedo, by M. Rouget. In opposition to MM. Boll, Ciaccio, and Ranvier, M. Rouget observes constantly, and reproduces by photography, a network in the ventral face, formed by the divisions of the last branches of the pale ramified fibres. The appearances of termination in buttons or free extremities, which show here and there in all the preparations, are manifestly connected with the network, in the enlarged photographs, by prolongations which escape direct observation.—Variations of the temperature during the total eclipse of the moon on August 24, 1877, by M. Berigny. There was a very marked cooling at 10 o'clock, and this had a perceptible effect on the minimum. M. Berigny asks did this arise from the astronomical fact, or was it a mere coincidence? M. Faye was not disposed to attribute it to the eclipse, and for two reasons: First, the sky was that night exceptionally clear, so that the terrestrial radiation must have been very active, giving a notable fall in the thermometer; second, physicists have had the greatest difficulty in rendering perceptible heat from the moon, even with the most delicate apparatus. So that when we are deprived of this radiation for an hour or two this can hardly affect our thermometers, still less our senses.

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