THURSDAY, OCTOBER 30, 1873

OUR NATIONAL MUSEUMS

WE may congratulate ourselves that the Museum question is now being taken up with vigour. Not only must the Royal Commission on Science include it among their inquiries, but the Society of Arts is directing public attention to it.

This is the more opportune, as the intention of the Government to transfer to irresponsible trustees the only museums under the direction of a Minister of State has recently been declared, and needs only to be declared to be condemned on all hands.

We now let the following documents speak for themselves. Next week we shall return to the subject :—

I.

Memorial to the Right Honourable W. E. Gladstone, M.P.

"1. We, the undersigned members of the Council and Members of the Society for the Encouragement of Arts, Manufactures, and Commerce, request the attention of Her Majesty's Government to the remarkable proof of the public desire for instruction and pure enjoyment afforded by the examination of works of Art and Science, which has been shown by the opening of the Bethnal Green Museum.

"2. This Museum, established in one of the poorest and busiest districts in London, where men, women, and children are most laboriously employed, has been frequented during three months by more than 700,000 visitors,* a number which probably exceeds that of the visitors to all the other metropolitan museums and galleries during the same period.

"3. The undersigned submit that this museum could never have come into useful existence, and have been instrumental in conferring great benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's Government, with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost."

Appended to this are the signatures of 250 Peers, Members of Parliament, and other well-known and distinguished men.

II.

CORRESPONDENCE RELATING TO THE ABOVE MEMORIAL.

"*The Secretary of the Society of Arts to the Right Hon. W. E. Gladstone, M.P.*

"July 3, 1873.

"SIR,—A memorial relative to the beneficial action of the Bethnal Green Museum, has been prepared by the Society of Arts for presentation to you.

"It has been signed by one hundred and fifty members of the Council and of the Society, of whom twenty-two are peers, and sixty-three are members of the House of Commons. In addition to the above, thirty-seven peers and sixty-three members of the House of Commons, not members of the Society, have expressed their concurrence in the object of the memorial.

"I am directed to request that you will have the kindness to receive a deputation to present the memorial, and to name a day for doing so, giving, if possible, at least a week's notice."

* "The numbers up to the end of September were upwards of one million and a half of people; to 31st December, 1872, only six months and a half, they amounted to 901,464, whilst the number of the general visitors to the British Museum for the whole year 1872 were only 424,068.—October 1873.

"*Mr. Gurdon to the Secretary of the Society of Arts.*

"July 5, 1873.

"SIR—Mr. Gladstone desires me to acknowledge the receipt of your letter of the 3rd inst., requesting him to receive a deputation to present the memorial from the Society of Arts, on the subject of the museum at Bethnal Green. I am directed to express Mr. Gladstone's sincere regret that the pressure of his duties, as First Lord of the Treasury, renders it absolutely necessary that he should confine his attention to those matters which fall directly within his province; and he therefore trusts that those on whose behalf you have written will kindly excuse him if he asks them to address themselves to the Privy Council Office."

"*The Secretary of the Society of Arts to Mr. Gurdon.*

"SIR,—I have brought before the Council your letter of the 5th July, in reply to mine of the 3rd July, asking Mr. Gladstone to receive a deputation to present a memorial from this Society on the subject of the Bethnal Green Museum. The Council observe that you express Mr. Gladstone's regret that the pressure of his duties as First Lord of the Treasury renders it absolutely necessary that he should confine his attention to those matters which fall directly under his province, and his trust that those on whose behalf the reception of a deputation was sought will kindly excuse him if he asks them to address themselves to the Privy Council Office.

I am directed, in reply, to point out that the memorial, having relation to a subject of vast importance to the education, general cultivation, and social welfare of the people, did appear to the Council to bring the subject strictly within the consideration of the Prime Minister, rather than of a department of the Government. Moreover, it did appear to the Council that the deep interest which the subject excites is manifested by the unusual character of the signatures, being those of 60 peers and 130 members of the House of Commons attached to the memorial, and justified the Council in asking for the special attention of Mr. Gladstone himself.

"Under these circumstances, the Council submit their conviction that the subject involves considerations of principle and policy worthy the attention of the Prime Minister of this country, and too wide in its political and fiscal considerations to be dealt with effectually by any single department of the Government.

"They, therefore, respectfully decline to adopt Mr. Gladstone's suggestion that they should address themselves to the Privy Council Office."

"*Mr. Gurdon to the Secretary of the Society of Arts.*

"SIR,—I am directed by Mr. Gladstone to acknowledge the receipt of your letter of the 18th inst., and to request that you will be kind enough to acquaint the Council of the Society of Arts that the intention of the reply to your communication of July 3 was to point out that, in regard to a subject of the nature of that which you brought before him (viz. the beneficial action of the Bethnal Green Museum), which falls properly within the province of a department of the State appointed to deal with it, the First Lord of the Treasury could not take the initiative out of the hands of that Department.

"This Mr. Gladstone would be doing were he to receive the proposed deputation; and he would be acting contrary to the rules of administration which are necessary for the conduct of public business.

"If, however, the Society of Arts think fit to favour him with a written communication, Mr. Gladstone will himself correspond with the proper department concerning it."

"*The Secretary of the Society of Arts to the Right Hon. W. E. Gladstone, M.P.*

"SIR,—The Council of the Society of Arts have directed me to reply to Mr. Gurdon's letter of July 22, in which he states that, 'if the Society of Arts think fit to place before you a written communication, you would yourself correspond with the proper department concerning it.'

"The deputation which desired to have the honour of waiting on you, and explaining in detail the objects of the memorial, would have stated that, in their view, the experiment of the Bethnal Green Museum is suggestive of the following points :—

"1. That a general popular desire exists for such museums, and that it would be good national policy for the Government to encourage the establishment of them.

"2. That like primary elementary schools, it would be impossible that such museums could, without State aid and inspection, become part of a national system, aiding technical instruction and secondary education.

"3. That this question, unfettered by any denominational difficulties, is quite ripe for solution ; that the necessary expenditure for aiding museums of science and art would be advantageous from every point of view, even remunerative as respects commerce ; and, further, would be auxiliary in promoting morality and social good order.

"4. That such museums are absolutely necessary to the industrial progress of the country, which is behind other countries already in the possession of them.

"5. That the time has come when it is necessary that all public museums and galleries of works of science and art receiving Parliamentary aid, should be brought under an intelligible system of administration, controlled by a responsible Minister of State, so as to render them auxiliary to the development of local museums and galleries.

"The Council submit that these are subjects not only of general policy, but involve some new principles of administration, large financial considerations, the reform of old institutions, &c., which it is the province of the general Government, and not of any single department, to deal with. The Council especially desired that the answer they might receive should come direct from yourself as Prime Minister. They could not hide from themselves the knowledge they possessed of the several departmental difficulties which attended the opening of the Bethnal Green Museum, and that they had been made cognizant, through Parliamentary returns and the revised estimates for 1871-2, of the opposition which the Treasury, as lately administered, had persistently offered to carry into effect the decisions made by Her Majesty's Government in 1866, for conducting the Bethnal Green Museum.

"The Council respectfully request you to have the kindness to bring this memorial before Her Majesty's Government. They hope it will meet with favourable consideration, and lead to decisive action ; and they will feel obliged by receiving an answer upon it at as early a period as convenient."

"*Mr. Gurdon to the Secretary of the Society of Arts.*

"SIR—Mr. Gladstone desires me to acknowledge the receipt of your letter of October 6th, the contents of which he will not fail to make known to his colleagues."

III.

Resolutions of the Council of the Society of Arts passed at their last Meeting :—

"1. That the undermentioned persons be invited to serve on a Standing Committee for the purpose of bringing under parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, and to make them bear on public Education. The following are the several objects in view for effecting this purpose :—

"2. All Museums and Galleries supported or subsidised by Parliament to be made conducive to the advancement of Education and Technical Instruction to the fullest extent, and be made to extend their advantages to the promotion of original investigations and works in Science and Art.

"3. To extend the benefits of National Museums and Galleries to Local Museums of Science and Art which may desire to be in connection, and to assist them with loans of objects.

"4. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

"5. For carrying out these objects most efficiently, to cause all National Museums and Galleries to be placed under the authority of a Minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament ; thereby rendering unnecessary, for the purpose of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

"6. To enter into correspondence with all existing Local Museums and the numerous Schools of Science and Art, including Music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of Local Museums.

"7. Also, to cause the Public Libraries and Museums Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

"Earl of Carnarvon.
Earl Russell.
Lord Elcho, M.P.
Lord George Hamilton, M.P.
Lord Houghton.
Lord Lyttelton.
Sir T. Acland, Bart. M.P.
Sir Antonio Brady.
Sir John Lubbock, Bart, M.P.
Right Hon. Sir Stafford Northcote, Bart., C.B., M.P.
Sir Wm. Thomson, F.R.S.
Sir S. Waterlow, Bart., Lord Mayor of London.
Sir Joseph Whitworth, Bart.
Right Hon. Sir John Pakington, Bart., M.P.
Right Hon. W. J. Henley, M.P.
Right Hon. Cowper Temple, M.P.
The Hon. Mr. Justice Grove.
Thomas Ashton, (Manchester).
E. A. Bowring, M.P.
Dr. Carpenter, F.R.S.
Henry Cole, C.B.
Montague Corry,
W. De La Rue, F.R.S.
E. B. Eastwick, M.P.
Gabriel Goldney, M.P.
Principal Greenwood (of Owens Coll., Manchester).
John Henderson, M.P.
Dr. Hooker, F.R.S.
C. Wren Hoskyns, M.P.
James Howard, M.P.
Prof. Huxley, F.R.S.
U. J. Kay-Shuttleworth, M.P.
George Melly, M.P.
S. Morley, M.P.
Dr. Mouat.
A. J. Mundella, M.P.
Prof. Roscoe, F.R.S. (of Owens College, Manchester).
Lyon Playfair, C.B., M.P.
Hodgson Pratt.
Prof. Ramsay, F.R.S.
C. Seely, jun. M.P.
Col. Strange, F.R.S.
E. Thomas, F.R.S. (Athenæum Club).
George Trevelyan, M.P.
Thomas Twining.
Prof. Tyndall, F.R.S.
G. W. Ward (Nottingham).
Prof. Williamson, F.R.S.
Also the Heads of the City Companies for the time being.
Also the Chairmen of Local Committees of Schools of Science and Art, and of Local Museums Committees.
Also the members of the Legislature who signed the Bethnal Green Memorial.

(By order) "P. LE NEVE FOSTER, *Secretary.*"

SPENCER'S DESCRIPTIVE SOCIOLOGY

Descriptive Sociology ; or, Groups of Sociological Facts. Classified and arranged by Herbert Spencer. No. I. —English ; compiled and abstracted by James Collier. (London : Williams & Norgate.)

NOT long since, an announcement appeared in NATURE of Mr. Herbert Spencer's plan of publishing, not a complete and finished treatise on Sociology, but a collection of classified materials for the use of students and investigators. The origin of this important work is explained in the following extract from the preface to Part I., which has now appeared.

"In preparation for the *Principles of Sociology*, requiring as bases of induction large accumulations of data, fitly arranged for comparison, I, some five years ago, commenced by proxy the collection and organisation of facts presented by societies of different types, past and present: being fortunate enough to secure the services of gentlemen competent to carry on the process in the way I wished. Though this classified compilation of materials was entered upon solely to facilitate my own work; yet, after having brought the mode of classification to a satisfactory form, and after having had some of the tables filled up, I decided to have the undertaking executed with a view to publication: the facts collected and arranged for easy reference and convenient study of their relations, being so presented, apart from hypotheses, as to aid all students of Social Science in testing such conclusions as they have drawn, and in drawing others."

An objection to this scheme, which struck most who noticed its announcement, was that materials thus arranged would form a patch-work of dead scraps, rather than an organic whole. The specimen which was first circulated, relating to one of the barbaric grades of culture, confirmed this unfavourable expectation. Now, however, that a section of the actual work has been published, it is evident that the scheme can be made to carry an interest of its own, and even to serve an educational purpose. This first section is a methodical summary of the development of England, intellectual and moral, from the beginning of its history in Cæsar's time, to about A.D. 1850. At the first glance, it suggests a question which may disconcert not a few of the lecturers and tutors engaged in training students in history at our Universities. This question is, whether the ethnological record of national life ought any longer to be treated as subordinate to the political record of the succession of rulers and the struggles for supremacy of ruling families, or whether the condition of society at its successive periods is for the future to be considered as the main subject, only marked out chronologically by reigns, battles, and treaties. This question has, it is true, been already raised. It is, in fact, the issue between historical chronicle and the philosophy of history as rival subjects of study. But Mr. Spencer's work brings it more clearly and practically into view than any previous one, as will be seen from the following outline of his scheme. It consists of two parts.

The first part is a series of tables, arranged in thirty to thirty-five columns, each with a heading of some department of social life or history, which again are combined into groups. Thus the group of columns relating to the structure of society takes in political, ecclesiastical, and ceremonial departments, under which again we find separately given the laws of marriage and inheritance, the regulation of tribes and castes, the military and ecclesiastical organisation, and the ceremonies and customs of daily life. Next, the group of columns devoted to the functions of society, regulative and operative, contains particulars of the morals, religion, and knowledge of each age, the state o language, and the details of industry, commerce, habitations, food, clothing, and artistic products. Three special columns at the beginning, middle, and end of this long colonnade, contain the skeleton of ordinary history: namely, the principal dates, names of rulers, and political events. Thus, by glancing across any one of the huge double pages, we see the whole condition of England at any selected period. Thus, in the century after the Norman Conquest, the influence of the invaders is observed in the growth of architecture, painting, music, poetry, the introduction of new food and more luxurious living, the importation of canonical law and of mathematics from the East, and so on through all the manifold elements which made up the life of noble and villain in our land. If the page be turned to the 16th century, the picture of English life is not less distinct. The scholastic philosophy is dying out, men's minds are newly set to work by the classical revival, by voyages into new regions, the growth of mercantile adventure and political speculation; chivalry ceases, archery declines; judicial torture is introduced, the "Italian" crime of poisoning becomes frequent; the ancient belief in witchcraft and pervading demons holds its ground, as do the miracle-plays and local festivals; but a highway act is passed, new roads are being made, the new houses have chimneys, their furniture and fare become more luxurious; the power of the old feudal families is destroyed, the Star-Chamber is new-modelled; church-fasts are still observed under pain of imprisonment, and high offices of state are still in the hands of churchmen, but among the signs of momentous change come the dissolution of monasteries, and the distinct appearance of a sect of Protestants. Thus the tabulated record goes on till it ends near the present day, among such items as Trades'-Unions, Divorce Courts, the Manchester School, County Courts, Free Thought, Railways, Rifled Cannon, Præ-Raphaelitism, Chartism, Papal Aggression, and the crowding events of modern manufacture and science.

It is by following the several columns downwards, that the principle of Evolution, the real key to Mr. Spencer's scheme, is brought out into the broadest light. It seems most strange, however, that he should not have placed in its proper niche the evidence of pre-historic archæology. Mr. Spencer can hardly doubt that the stone implements found in England prove the existence of one, or probably two, stone-age populations before the Kelts, who, under the name of Ancient Britons, begin his series. If he acknowledges this, why should a first link so important in his chain of evolution have been dropped? Otherwise the chain is carefully stretched out so as to display it from end to end. In many matters simple and direct progress is the rule. From the Ancient Briton's bow with its bronze-tipped arrows, to the cross-bow, the matchlock-gun, and thence through successive stages to the rifled breech-loader; from the rude arithmetic before the introduction of the "Arabic" numerals, through the long series of importations and discoveries which led to the infinitesimal calculus in its highest modern development; from the early English astronomy, where there was still a solid firmament studded with stars, and revolving on the poles about the central earth, to the period when the perturbations of planets are calculated on the theory of gravitation, and the constitution of the fixed stars examined by the spectroscope—these are among the multitude of cases illustrating the development of culture in its straightforward course. Harder problems come before us, where we see some institution arise, flourish, and decline within a limited period, as though resulting from a temporary combination of social forces, or answering only a temporary purpose in civilisation.

To take an instance from Mr. Spencer's Table, English history has seen the judicial duel brought in at the Conquest, flourishing for centuries, declining for centuries more, till its last formal relic was abolished in 1820. Again, in the Old English period, marriage appears as a purely civil contract, on the basis of purchase of the wife; then with Christianity comes in the religious sanction, which by 1076 had become so absolute that secular marriages were prohibited: with a strong turn of the tide of public opinion, the English Marriage Act of 1653 treated marriage as a civil contract, to be solemnised before a justice of the peace; till after a series of actions and re-actions, in our own day the civil and ecclesiastical solemnisation stand on an equal footing before the law. Closely similar has been the course of English society on the larger question of a National Church, which, soon after the introduction of Christianity, claimed an all but absolute conformity throughout the nation, practically maintained the claim for ages, and then was forced back to toleration, which has at last left it with a supremacy little more than nominal. This is not the place to discuss these subjects for themselves, but to show how the table before us, by its mere statement of classified events in chronological order, must force even the unwilling student to recognise processes of evolution in every department of social life. The writer of the present notice once asked an eminent English historian, a scholar to whom the records of mediæval politics are as familiar as our daily newspaper is to us, whether he believed in the existence of what is called the philosophy of history. The historian avowed his profound distrust of, and almost disbelief in, any such philosophy. Now it may seem a simple matter to have tabulated the main phenomena of English social and political history in parallel columns, as Mr. Collier has here done under Mr. Spencer's direction, but his tables are a sufficient answer to all disbelievers in the possibility of a science of history. Where the chronicle of individual lives often perplexes and mystifies the scholar, the generalisation of social principles from the chronicler's materials shows an order of human affairs where cause and effect take their inevitable course, as in Physics or Biology.

It may be objected, however, that summing up complex events in short headings, and arranging these in columns, is a rough and ready method often leading to erroneous inferences, and even liable to gross error. It is evidently in order to guard against this that Mr. Spencer follows the first part of his scheme by a second. Here, under their proper headings, the passages from standard authorities which vouch for the brief statements in the tables are given in full, and with references. This part of the work, much the largest in extent, is thus an elaborate historical commonplace-book, containing some thousands of selected quotations. Mr. Collier is on the whole to be congratulated on the completeness of his reading, and the discrimination with which he has chosen his passages. So much information, encumbered with so little rubbish, has never before been brought to bear on the development of English institutions. There is hardly a living student but will gain something by looking through the compilation which relates to his own special subject, whether this be law or morals, education or theology, the division of labour or the rise of modern scientific ideas. Of course it is very far from perfect. There are some actual blunders; a weak authority is often taken where a strong one was to be had; small matters are often put in, and large ones left out; the want of notes leaves no opportunity of correcting an author's half-true statement. Thus under the heading of Accessory Institutions, there is a good account of the Royal Institution and the Pharmaceutical Society, and a mention of the Russell Institution and the Swedenborg Society, but not a word of the Royal Society. An extract from the Pictorial History of England ascribes the system of Sunday Schools to Mr. Robert Raikes, of the *Gloucester Journal*, about 1780, whereas their real inventor, Jonas Hanway, flourished at an earlier date. Again, under the heading of Religious Ideas and Superstitions, various slips are to be noticed. It was natural enough that, years ago, Brand should, in his Antiquities, have considered the country rite of throwing toast to the apple-trees to secure a fruitful year as being a "relic of the heathen sacrifice to Pomona;" but a modern reader quoting him, should never in Brand's old-fashioned way have dragged in a Roman deity to account for a genuine English superstition. Just below this is the following sentence in brackets, and without an author's name:—"The resistance of tides in the Wash caused by their meeting with the ebb-waters is called the Ægar—one of the gods of the Scandinavian mythology." This statement is misleading, and not the less so for having a real etymology hidden behind it. Our English word *eagre*, signifying the "bore" of an estuary, is Anglo-Saxon *eagor*, the sea, and its use merely asserts the plain fact that the sea runs up the channel. It is true that there is a corresponding old Norse word *œgir*, the sea, and that this in Scandinavian mythology becomes the personal name of *Œgir*, the Sea-god. But it does not follow that our eastern counties' word had ever any such mythological notion attached to it. These happen to be the first weak points which struck the writer in glancing over a page or two in quest of errors. It is needless to continue this critical process on a professed book of extracts; enough has been done to show that the proper use of such a work as the present is not so much to furnish the scholar with complete second-hand ideas, as to indicate how the ideas lie and where they may be obtained first-hand.

Mr. Spencer, out of the evidence amassed by the readers collecting facts under his direction, might have made an admirable treatise of the usual kind on the History of English Civilisation. No doubt, however, for years to come lectures will be delivered and articles written full of suggestive facts in the history of culture, which the initiated will recognise as borrowed from the unwieldy pages of this present atlas-like compilation. In the meantime, we may hope that Mr. Spencer's scheme may be carried out through the whole range of savage and civilised life, and that his tables of development of culture (printed on one side of the paper as if in anticipation of such use), may be set up like maps on the walls of class-rooms. They are certainly to be compared with maps for the range and precision and correlation of parts with which they show their contents at a glance.

E. B. TYLOR

OUR BOOK SHELF

Aus der Urzeit. Bilder aus der Schöpfungsgeschichte, von Prof. Dr. Karl A. Zittel, in München. Mit 78 Halzschnitten. (München : Rudolph Oldenbourg, 1871-2.)

THIS is one of a series of popular works on Science entitled "Die Naturkräfte," that are being published at intervals by Herr Oldenbourg, of Munich. Prof. Zittel, in his preface to the present work, speaks of the vast influence which popular scientific literature is calculated to have upon the entire development of a people, and therefore insists on the great importance of diffusing, in an intelligible manner, among the people thoroughly correct notions of every science, instead of mincing down scientific truths until they lose all that is characteristic or informing. It is, perhaps, of far more importance that scientific books meant for the people should be as absolutely correct and as far advanced as it is possible to be, than those intended for scientific men themselves. The latter can discover and reject the false or imperfect ; the former in their ignorance accept what is written as the truth, and the injury thus done is often serious in its consequences and may take a generation or longer to remedy. Popular scientific works, like school text-books of science, ought to be written only by those who are thoroughly masters of their subjects. The book before us seems to us to be in this respect satisfactory. In a series of chapters, each corresponding mainly with one of the great geological periods, the author endeavours to present a series of pictures of the gradual development of our earth, mainly with reference to the life which it supports. He seems to know his subject well in all its aspects, and presents in an interesting and intelligible way the latest results of geological research, with the conclusions derived therefrom by the most advanced thinkers. The illustrations are very good, and the work as a whole is a good specimen of a popular scientific treatise.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Remarkable Phenomena

IT may be within the memory of some of your readers that between the 15th and 20th August, 1868, a succession of waves reached Sydney, and were recorded by the self-registering tide-gauge. The average interval between the waves was about 25 minutes, and the greatest oscillation 34 inches, measuring from the crest of one wave to the hollow of the next. It was thought at the time that they were earthquake phenomena.

A similar visitation has just reached us, but it was not so marked in its character. The self-registering tide-gauge shows that the disturbance began during the afternoon of the 15th, and attained its maximum between 1 A.M. and 4 A.M. of the 17th, the greatest oscillation, amounting to 5 inches, occurred between 3.15 A.M. and 3 33 A M. of the 17th, the average interval of the waves at this time was 25 minutes, but the average of 20 between 8 P.M. and 5.30 A.M. was 28 minutes. The waves cannot be traced beyond the 18th.

On the afternoon of the 16th we had a thunderstorm, during which the barometer was very unsteady, and the barograph sheets show some peculiar curves ; strange to say, the average interval of the 5 most conspicuous of the barometer curves or waves between 5.40 P.M. and 7.30 P.M. is 25 minutes ; the largest oscillation was 0·045 in. of mercury, equal to about 6 inches of water. Just before daylight on the morning of the 17th several fine meteors were seen to N.E., but the observer who reported them to me did not make notes of particulars. At Newcastle, which is a port 60 miles north of Sydney, I have another self-registering tide-gauge, which recorded a disturbance similar to the Sydney one ; it began on the afternoon of the 15th and was greatest between 8 P.M. of 16th and 7 A.M. of 17th ; the greatest oscillation, 9 inches, occurred between 12.15 A.M. and 12.30 A.M. of 17th, and the average interval of all the waves from 8 P.M. to 5.3 A.M. of 17th, amongst which are several that only occupied 5 minutes, and look like double oscillations, is 20 minutes.

Struck by the circumstances that both sets of waves, though separated by an interval of 5 years, occurred in August, I determined to examine all the tide-gauge sheets since 1866, when the instrument was set up, and was surprised to find a repetition of it every year, the amounts were too small individually to attract notice, but are nevertheless unmistakable, the periods are as follows :—

1866 August	9th to 10th, and again 15th to 21st.	
1867 ,,	5th ,, 13th, very marked from 9 A.M to midnight of 12th.	
1868 ,,	15th ,, 20th, remarkable (see beginning of this letter).	
1869 ,,	11th ,, 17th.	
1870 ,,	12th ,, 22nd, marked from 5 P.M. of 17th to 4 P.M. of 18th.	
1871 ,,	9th ,, 10th and 20th to 21st.	
1872 ,,	10th ,, 13th.	
1873 ,,	15th ,, 18th, as recorded in this letter.	

It is not easy to believe that earthquake phenomena will recur with such regularity, and we must seek another cause depending it would seem on the earth's annual motion, and to a certain extent affecting air and ocean alike.

It would be premature to express a decided opinion without further investigation, which I have not had time to make yet, but it seems very probable that the August meteor stream through or near which the earth passes about 10th August may be the cause. It will be observed that even in the few observations given above there are indications of a five-year period ; for the double disturbance of 1866 is reproduced in 1871, and the great disturbance of 1868 is followed by a similar one in 1873.

Sydney Observatory, Aug. 23 H. C. RUSSELL

Periodicity of Rainfall

I DO not altogether agree with Governor Rawson when he says, in his interesting letter in NATURE, vol. viii. p. 245, that "the experience of Barbados is opposed to the theory broached by Mr. Meldrum and Mr. J. N. Lockyer." On the contrary, I rather think that Mr. Rawson's figures support the theory. He has taken 1846 and 1871 as middle maxima years (in my first paper I also took 1848), whereas 1849 and 1872 are probably more correct. Making this slight alteration, we get, according to Mr. Rawson's statistics :—

	Years.	Rain. In.	Sums. In.
Min.	1843	45·31	163·67
	1844	74·45	
	1845	43·91	
Max.	1848	63·77	184·42
	1849	52·77	
	1850	67·88	
Min.	1855	77·31	186·70
	1856	48·49	
	1857	60·90	

	Years.	Rain. In.	Sums. In.
Max.	1859	56·22	
	1860	57·91	187·95
	1861	73·82	
Min.	1866	59·68	
	1867	69·93	174·21
	1868	44·60	
Max.	1871	41·46	
	1872	48·39	154·85
	1873	65·00	

Grouping the results we obtain:—

Rain in Max. Years.	Rain in Min. Years.
184·42	163·67
187·95	186·70
154·85	174·21
527·22	524·58

; showing an excess of 2·64 in. on the maximum side.

The quinquennial periods, as far as they admit of comparison, give also an excess in favour of the maxima years.

The heavy falls in 1844 and 1855, and the comparatively small fall in 1872, are apparently opposed to the theory; but it should be borne in mind that rainfall is greatly affected by local causes, and that to reveal the effects of a weaker but more general cause we must, as far as possible, eliminate chance, by comparing the total falls in maxima and minima periods. Tried by this preliminary test, the experience of Barbados can scarcely be said to be opposed to the theory.

My main object, however, is to draw attention to some discordances between Mr. Rawson's figures and those given by Mr. Symons in NATURE (vol. vii. p. 143); for until this disagreement be explained, there will be considerable uncertainty respecting the rainfall of Barbados. The following table will show where the two statements are at variance:—

	Years.	Rain. (Mr. Symons.)		Rain. (Mr. Rawson.)	
Min.	1843	45·3		45·31	
	1844	74·5	163·7	74·45	163·79
	1845	43·9		43·91	
Max.	1847	42·5		48·10	
	1848	62·8	158·3	63·77	164·64
	1849	53·0		52·77	
Min.	1855	73·5		77·31	
	1856	46·4	170·7	48·49	186·70
	1857	50·8		60·90	
Max.	1859	55·1		56·22	
	1860	60·4	186·6	57·91	187·95
	1861	71·1		73·82	

The greatest differences are in 1847, 1855, and 1857, and amount (for these three years alone) to 19·4 in.

It is worthy of remark that both statements show an excess on the side of the maxima years; Mr. Rawson's of 2·2 in., and Mr. Symons's of 10·5 in. But how did such great differences arise.

A remark made by Mr. Rawson may explain the matter. He says "the average of the island for twenty-five years, from 1847 to 1871, is 57·74 inches, based upon the mean of three stations in 1843, and increasing to 141 in 1871." Now it would be useful to know how the mean yearly rainfalls were determined. Is the fall given for 1844 (74·45 inches) a mean of the falls at three stations, and the fall for 1872 (48·39 inches) a mean of the falls at 141 stations? If so, and if the other yearly means were similarly obtained, Mr. Symons may not have taken the same number of stations as Mr. Rawson. Yearly means thus determined would not of course be comparable, for even in a small island the rainfall varies greatly according to locality. The rainfall in maxima and minima sunspot years cannot be fairly compared except by taking the same number of gauges and the same stations; and it is desirable that the falls in the intervening years should be given.

"Assuming that sunspots affect all parts of the globe *equally*, and that periodicity prevails in all *alike*," Mr. Rawson, with the above experience of Barbados before him, is "led to the conclusion that it was 'chance alone' that led to the coincidences noticed by Mr. Symons." Now the theory makes neither of these assumptions. It assumes that there is a sunspot periodicity; that this periodicity implies a secular variation of solar heat and radiation; that, therefore, there is a corresponding periodicity of temperature, wind, and rain on our earth; but that, from various counteracting causes, the observations at some stations will not show a periodicity, while those at a large majority of stations, and a mean of all the observations, will do so. In short, with respect to rain, the theory assumes that the annual fall over the globe is subject to a variation, corresponding with the sunspot variation, but that from disturbing influences, local exceptions must be expected. Granting, therefore, that the rainfall of Barbados is opposed to the theory, I do not think it follows that the favourable experience of the British Isles must be owing to chance alone; for that experience is what theory leads us to expect, and it is much more extensive both as to time and space than the experience of Barbados. If England and Barbados were the whole globe, the theory would be well-nigh proved, as far as observation goes; for, according to Mr. Symons's Table I, there was not, from 1815 to 1864, a single exception to the rule that more rain falls in the maxima years; and if we take the aggregate falls for England and Barbados from 1843 to 1873, it will be found that there was a large excess on the maximum side.

I have now examined 93 rainfall tables from various parts of the globe. They are all I have as yet been able to procure, and they have been published *in extenso*, so that the evidence they afford may be scrutinised. That evidence is such that if no rain at all had fallen at Barbados in the nine principal maxima years since 1843, and the rainfall in the nine minima years were to be put in the other scale of the balance, there would still be a large surplus in favour of the theory. Up to the present time the more numerous the observations, the stronger the evidence. Still I shall be prepared to abandon the theory whenever a preponderance of undoubted facts may be brought against it. But I see no prospect of this, for the rainfalls of England, Scotland, the Continent of Europe, India, Africa, America, and Australia, as far as they have yet been examined, sustain the theory.

C. MELDRUM

Mauritius, Sept. 15

Dr. Sanderson's Experiments and Archebiosis

DR. SANDERSON has strangely misunderstood the wording of my letter which appeared in NATURE on the 9th inst. Any one may see that I did not challenge him to "deal" with my main proposition "that Bacteria are capable of arising in fluids independently of living reproductive or germinal particles." That position was merely alluded to by me in order to show the relevancy of the question which I asked Dr. Sanderson: and the question itself was—"Whether he still believes that Bacteria are killed by a temperature of 100° C. in fluids; and if not upon what grounds he has changed his opinion?"

Whilst tacitly declining to answer this question, Dr. Sanderson now says, "I hope that Dr. Bastian will allow me to decline to enter on the general question." But it is precisely because Dr. Sanderson has distinctly expressed himself upon the general question both at the late meeting of the British Association and in your columns (NATURE, vol. viii. p. 181), that I feel he may, both from a moral and from a scientific point of view, be called upon to reply to the question above quoted.

The need that Dr. Sanderson should express the grounds of his opinion concerning the death point of Bacteria in heated fluids is further shown by Mr. Ray Lankester's communication in last week's NATURE, in which he says, "Dr. Sanderson does not believe that there is a definite relation between the precise temperature to which the infusion is exposed and the destruction of Bacterian contamination." Now if this is really Dr. Sanderson's present opinion, it may not inappropriately be asked whether it is an opinion based upon definite evidence or whether it is a mere surmise? I say the question is not inappropriate because, as Dr. Sanderson will recollect, I have heard from his own lips, since his return from Bradford, that he has made no definite observations upon the subject, and that he is quite unprepared to question the truth of the experimental evidence which I have recently brought forward (Proceed. of Royal Society, Nos. 143 and 145) showing that Bacteria are killed in fluids which have been raised for five minutes to a temperature of 60° C. (140° F.)*

Dr. Sanderson previously supposed that Bacteria were incapable of appearing and rapidly multiplying in certain fluids

* I should have hesitated about referring to what has passed in conversations between Dr. Sanderson and myself, if he had not set the example both in your columns (NATURE, vol. viii. p. 181) and in a discussion at one of the meetings of the Royal Society.

raised to 100° C. and subsequently protected from contamination. He has been convinced that his supposition on this subject was erroneous. And since this period, whilst I have been careful to undertake fresh researches concerning the death point of Bacteria, he has been content to rest in the stage of mere supposition on this most important point, and is now, as it appears, quite unprepared to question the truth of my assertion that Bacteria are killed at 60° C. It is right that the public should know this, and I only regret that Dr. Sanderson himself cannot be induced to inform them as to the real extent of his knowledge upon this part of the subject.

H. CHARLTON BASTIAN

University College, Oct. 20

Foreign Orders

THE acceptance and refusal of foreign orders by British subjects has hitherto been universally misunderstood. The existence of the Queen's Regulations, which you have reprinted in your columns (vol. viii. p. 481), prohibiting the receipt of these orders without special permission, must, after the discussion which took place in the House of Commons during last session, surprise many of your readers, who will naturally ask why regulations so stringent and so habitually disregarded, have been either kept entirely private in the Foreign Office, or, if published, have never been followed up. As it is, I will venture to say that not one out of some hundreds who have received foreign orders are aware of the prohibition or have any obvious means of becoming aware of it. Announcements of the presentation to British subjects (and it is assumed acceptance of by them) of such orders habitually appear in the most conspicuous type of the most widely circulated papers, but never a hint on the part of the Foreign Office that the recipients are violating Her Majesty's rules, as drawn up by itself and signed by the Secretary of State for Foreign Affairs.

Such being the case, it is somewhat singular that the Foreign Office should issue regulations approved by Her Majesty, forbidding British subjects to accept or to wear foreign orders and their decorations, except in the very rare cases in which Her Majesty's permission is obtainable, and yet take no steps through its agents at foreign courts to instruct the habitual givers that Her Majesty not only disapproves of their action, but requires of her subjects to tell them so in the most ungracious of all ways, namely by refusing to accept their favours, and returning the tokens thereof.

Surely if the prohibition to accept is wise and good (and I am the last person to doubt Her Majesty's wisdom) the obvious course for the Foreign Office to pursue is to inform all foreign Sovereigns of the fact, and instruct British subjects to transmit any orders that they may receive or have received to the Foreign Office to be returned to the sovereign who sent them, if the services of the recipient are not of such a nature as to enable him to obtain permission to accept them.

Into the merits of the prohibition I am not disposed to enter at much length. That foreign orders are comparatively valueless in themselves is generally admitted ; and it is well understood that not a few are to be had for the asking by men of real or supposed eminence, and others by solicitation from men of no eminence at all, or of doubtful eminence. It would surprise your readers to know how many of these orders there are in the possession of their countrymen, whose habitual disregard of such honours leads them in most cases to toss them into a drawer and say nothing about it to any one but their wives, who think they would suit their necks better than their husbands' long-tailed coats.

Some few (very few) no doubt have a definite scientific or literary value ; but so long as the British public are entirely ignorant of this value, they will be held in no higher estimation than the others, nor do I see any way by which the value of a foreign order could be made known and recognised, or by which the title of the recipient to wear it could be appraised

I believe that it is to the rarity of British orders that any desire to obtain foreign ones is mainly due. Had we more, or none, their value would diminish or expire ; as, however, I am not prepared to propose either the restriction or multiplication of British orders, a third alternative might be suggested to the Foreign Office, and that is the command to wear them if accepted ; which would result in a display in our *soireés* and assemblies of which men of eminence would be heartily ashamed, and lead to a petition for relief, that would be followed by an abandonment of the practice of giving by the powers that be. D.C.L.

Mr. Forbes on Mr. Mallet's Theory of Volcanic Eruption.

I DO not intend to depart from my purpose, as stated in my last (NATURE, vol. viii. p. 485), to have done with further controversy. I must, however, beg your permission to correct a statement as to a matter of fact which constitutes the prominent feature of Mr. D. Forbes' letter on the above, and which is published in the last number of NATURE.

Mr. Forbes says, and begs your readers to remember that his remarks [namely, in his original review of my translation of "Palmieri"] were altogether directed to the assertions contained in my introductory sketch, and not *comments upon my theory of volcanic energy*—of which Mr. Forbes now says we, viz., he and your readers, as yet know little or nothing. That is to say, nothing beyond what is given in the abstract in the Proceedings of the Royal Society and in my Introduction to Palmieri.

Mr. Forbes' review (NATURE, vol. vii. p. 259) which called forth this correspondence, was no doubt confined to my translation of, and introduction to, "Palmieri's Vesuvius," &c. But in that same introduction was contained a sketch of my theory of volcanic energy—upon which Mr. Forbes deemed himself warranted to make his sweeping condemnation—that it was not probable that this hypothesis will receive the adhesion of either chemist, mineralogist, or geologist.

If this were not a comment upon my theory of volcanic energy I know not what a comment means.

My complaint has been that it was a comment condemnatory —based on erroneous as well as inapplicable premises—and made at a time when, as Mr. Forbes himself in his last admits, he knew very little about that theory, as fully expounded in my paper in the Phil. Trans. ROBERT MALLET

Oct. 28

Settle-Cave Report

I HAVE just read with considerable astonishment Mr. Tiddeman's letter (NATURE, October 23) relating to an abstract which I never saw till to-day, and for which, therefore, I am not responsible. The whole question of the antiquity of cave-deposits as well as thatof those in the Victoria Cave, in particular is treated in my work on "Cave-Hunting," shortly to be published, and therefore I see no reason for entering into any argument based on the distribution of the Pleistocene Mammalia, or to depart from my rule of not entering into a controversial correspondence. W. BOYD DAWKINS

Owens College, Manchester, Oct. 24

The Oxford Science Fellowships

I WRITE to confirm Prof. Clifton's letter (in the last number of NATURE) respecting Mr. Perry and Oxford Science Fellowships. Nothing, it seems to me, can be more conclusive than the way in which Mr. Perry's letter has been answered. Any remark further of mine on this point would be superfluous.

I will only say that, in the practical part of the examination, no subject could have been chosen better fitted for giving perfectly fair play to all concerned. If it were possible to imagine that any advantage was given, it was, by the choice of the subject, given to those who were unacquainted with the University laboratory.

In conclusion—far from being looked on as an unwelcome intruder, I met with from all, whether candidates or examiners, the most generous courtesy and kindness.

Cambridge, Oct. 24 THE CAMBRIDGE B.A.

PROFESSOR CLIFTON cannot have considered what a great mistake I have been the victim of, or he would not in his hastily written attempt to defend the general science arrangements at Oxford, have forced me to the following explanation. He knows that I stated my case fairly, and he might surely have given credit for this whilst letting us have the benefit of his later information.

1. I have not at hand a copy of my letter to the Warden. I am quite sure that I told him I was a graduate of the Queen's University in Ireland. The Warden simply directed me to the short notice in the *Times* (afterwards given in your columns), said that the election would not be limited to graduates of Oxford, and would altogether depend on the results of the examination held at Merton on Oct. 7. I thought this letter perfectly satisfactory

as to my eligibility, as did several Oxford graduates to whom it was shown. I shall presently refer to Prof. Clifton's "warning."

The examination was to begin on Oct. 7, at 9 A.M. On presenting myself, a gentleman whose name I do not know, told me that the Physics papers would not be given out before Oct. 10, that if I felt inclined to work the paper given to candidates for the *Mathematical* Fellowship I might do so, and credit would be given for Mathematics in the event of two men being equal in the Physics examination. I shall not comment on this promising arrangement, or on the fact that the candidates for the Physics fellowship had not till then heard of the Mathematical paper. Our informant told me that there were grave doubts as to the eligibility of outsiders. He certainly gave me to understand that these doubts extended to *all* who were not Oxford graduates. I understood that some Cambridge men had presented themselves also; that the question of our eligibility was about to be settled with the Registrar of the University, and that if I called on the Warden between four and five in the afternoon (the time mentioned in the original notice) he would be provided with the results of the deliberations.

At 4.30 I found the Warden about to go away somewhere. I had an audience of about two minutes; was asked what College I belonged to (meaning in Oxford).—Not an Oxford man, I answered.—Then he was afraid I was ineligible. I then informed him that I was the graduate of the Queen's University, to whom he had written in June. I suppose he had very little time for apologies, but he let me know, before leaving, that he had misinterpreted the results of some late commission when he wrote in June, and that I need have no hope.

I have stated the grounds for my former general statement. If Prof. Clifton is certain that graduates of Dublin and Cambridge are eligible, we must rely on his information being most correct, but I am troubled to know who is answerable for my being left in ignorance until now, and if anybody knows whether elections are never made of men who would really be ineligible by the laws of the University.

2. He insinuates a deception on my part, in not mentioning his "warning." I take it that Prof. Clifton has partly forgotten the matter of which he speaks. I wrote to him for leave to inspect the Physical Laboratory at Oxford, not certain that he was one of the examiners, but aware that he had charge of that institution and that the examination *must* be held there (see 3). I did not speak of my eligibility.

There is no doubt about the fact that great difficulties are thrown in the way of outsiders, but I should have been wrong if I had laid any blame on Prof. Clifton for taking the only course open to him. The case is simply this: according to the present Physics arrangements at Oxford, outsiders preparing for the October Fellowship examination at Merton could not without giving the greatest imaginable trouble to Prof. Clifton get any opportunity of inspecting the apparatus.

After stating that he was unable to afford me the desired opportunity, he asked if I had ascertained about my eligibility, informing me that the warden or sub-warden was the proper person to apply to. I immediately wrote *that I had already made such an inquiry*, stating the result.

I now infer that he, after receiving my letter and aware that I had made the proper inquiries, allowed both the Warden and myself to remain in ignorance of the grievous mistake. On receiving no answer I felt perfectly certain that the information received from the Warden was correct.

When I last wrote to NATURE I felt grateful to Prof. Clifton for his inquiry, incomplete and worse than useless "warning" as it had been. Surely no one will think that I had any right to introduce his name.

3. He says it was by no means certain that the Practical Physics examination would be held in the Physical Laboratory. Will he assert that in any one of the nineteen colleges of which he speaks, or in the nineteen collectively there is apparatus for conducting such an examination?

He wonders why it should be necessary to inspect the particular apparatus to be employed in the examination. I do not know if Prof. Clifton was really one of the examiners for the fellowship, but surely he cannot have thought about the matter without being aware of the immense importance of a previous acquaintance with the apparatus such as Oxford men are sure to have. I heard by accident in July that there was no delicate apparatus, nor were proper arrangements made for exact experiments in Static Electricity. Can Prof. Clifton not understand that to an outsider such information might be of the greatest importance.

"What arrangement of telescope stand is there for measuring wave-lengths?" "Is there a Soleil's instrument for measuring the angle between the axes in biaxial crystals?" "Will the arrangements for observing deflections of a needle enable us to employ the logarithmic decrement?" These questions and a hundred others as important were constantly distracting me during the four months of preparation.

My letter to Prof. Clifton was, I believe, modest, and showed my respect for him as a man who had done a great work in his attempt to create a Physics School at Oxford. My request was not "unreasonable." I did not know that his presence was necessary during an inspection of the Physical Cabinet of the University. I maintain too, that he has no right to assert that I must feel very uncertain about my own practical knowledge.

London, Oct. 28 JOHN PERRY

Simple Diffraction Experiment

THE apparatus for this experiment consists of a slit and a grating. A slit may be made by ruling a line on a piece of smoked glass. The grating is made by slightly greasing the thumb and forefinger (there is naturally sufficient on the hot and moist hand), and by drawing a piece of clean glass through them so as to obtain alternate parallel light spaces and greasy lines on both sides of the glass; out of several trials a grating may be made which when used in the following manner will give very pretty results.

The grating being placed close to the eye, the slit (with its direction parallel to that of the lines on the grating) is held up before some bright light, as of a candle, and looked at, as if the grating did not exist. Very beautiful and numerous spectra may then be seen ranged on each side of the slit.

The vitreous surface of window glass does not seem to give such good gratings as a worked and polished surface, as for instance that of a weak spectacle lens.

Oxford H. L.

Publication of Learned Societies' Transactions

IN NATURE, vol. viii. p. 506 Mr. Röhrs wishes that our learned societies would publish their papers separately. I have urged this before in NATURE, but unsuccessfully. With Transactions such as those of the Royal Society, the present system is almost an absurdity, for papers on most incongruous subjects are bound up together, and the cost is too great. When once a paper is printed, the Council seem to think that there is nothing more to be done, and do not in any way try to make the work known. All papers should be sold separately as cheaply as possible, and on publication, should be advertised in the scientific journals.

If this were done, we should not have men like Prof. Sylvester writing as follows:—"I owe my thanks to M. Radau and the editor of the Annals of the Ecole Normale Superieure for having been at the pains to disentomb the little known conclusions contained therein from their honourable place of sepulture in the Philosophical Transactions." W. B. GIBBS

EXAMINATIONS OF THE SCIENCE AND ART DEPARTMENT IN BIOLOGY

THE syllabus of the Biological subjects in which examinations are held by the Science and Art Department, has undergone considerable modifications in the edition of the Directory which has been recently issued. Animal Physiology, Elementary Botany (including Flowering Plants only), are subjects which at present appear to be best adapted for the purposes of school instruction. They stand, therefore, in no necessarily logical relation to the other two which are grouped together under the head of General Biology. These involve the use of the compound microscope, and some amount of microscopic manipulation. They are therefore better fitted for rather more advanced, or at any rate, older students than the first stages of the subjects first mentioned.

The two subjects included under General Biology have a common first or Elementary stage. After passing this, the candidate may proceed at choice, either with the zoological or the botanical side.

The following extract from the syllabus will show how this arrangement is intended to work, and will afford the best idea of the direction which the examination is likely to give to elementary biological study. It does all that a written examination can do to encourage practical work, and discourage the prevalent habit of cramming from text-books :—

SUBJECTS XVI. AND XVII.—GENERAL BIOLOGY

First Stage or Elementary Course

Questions will be confined to the following subjects with which the candidate will be expected to show practical acquaintance.

1. The form and size; the results of optical, chemical, and mechanical analysis; the mode of growth and multiplication; the conditions of life; and the results, direct and collateral, of the living activity of *Torula*, *Protococcus*, *Amœba*, *Bacterium*, and of the colourless corpuscles of the blood of man.

2. The structure and mode of growth of *Penicillium*; its mode of multiplication; the development of *hyphæ* and *mycelium* from *conidia*: the conditions and results of the living activity of this mould.

3. The structure and mode of growth of *Chara*; the differentiation of axis and appendages, of nodes and internodes; the structure and arrangement of the nucleated cells of which the body of this plant is composed. The process of cell-division and its laws; protoplasmic movements; Chlorophyll; asexual propagation; sexual propagation. Development of the pro-embryo and of the embryo.

4. The structure and mode of growth of a Fern. The differentiation of cells into tissues. Epidermis, parenchyma, fibres, ducts, spiral vessels. The Frond as a respiratory and alimentary organ; air-passages; stomata. Asexual multiplication. Sporangia and spores. Development of spores; structure of the Prothallium. Structure and functions of Archegonia, Antheridia and Antherozoids. Development of the embryo.

5. The anatomy and physiology of a flowering-plant, with especial reference to the morphology of the stem and root. Leaves and their modifications. The structure of pollen and ovule. The process of impregnation and the development of the embryo. The resemblances and differences between flowering-plants and ferns.

6. The anatomy and physiology of the frog. The general disposition of the parts of the body, and the plan of structure characteristic of the frog as a vertebrated animal. The structural characters of the tissues of which the body is composed and their ultimate resolution into nucleated cells.

The physiological properties of the tissues.

The form and structure of the chief organs and the modes in which their functions are performed.

The development of the embryo and the metamorphoses of the larva.

7. The anatomy and physiology of the freshwater Polype.

8. The anatomy and physiology of the Lobster or Cray-fish.

9. The anatomy and physiology of the fresh-water Mussel.

10. The anatomy and physiology of the Sea-anemone.

Second Stage or Advanced Course of Subject XVI.

(Division of Animal Morphology and Physiology.)

Questions may be set in all the topics enumerated under the first head, and in addition on :—

The leading facts relating to the anatomy and physiology of the skeleton, of the brain, and of the cerebral nerves; of the organs of the higher senses; of the alimentary, circulatory, respiratory, renal, and reproductive apparatus, in the Lamprey, in an osseous fish (Pike or Cod), bird (Pigeon, Fowl, or Duck), in a quadrupedal mammal (Sheep, Rabbit, Dog, or Cat,) and in Man.

2. The morphology of the vertebrate skull and limbs, as exemplified by the *Vertebrata* already mentioned, and by the Dogfish, Horse, Bat, and Porpoise.

3. The general outlines and process of the development of the chick within the egg.

4. The characters of the orders of the *Vertebrata*.

5. The broad facts relating to the geographical and geological distribution of the *Vertebrata*.

6. The anatomy and physiology of insects, as illustrated by Blackbeetle, a Bee, a Butterfly, and an Aphis.

7. The anatomy and physiology of an Earthworm and of a Leech.

8. The anatomy and physiology of a Fluke and of a Tapeworm, and the history of their development.

9. The anatomy and physiology of the *Rotifera* and of the *Polyzoa*.

10. The anatomy and physiology of a Sea-urchin (*Echinus*) and the history of its development.

11. The anatomy and physiology of a Snail and of a Whelk, and of a Cuttlefish, Squid, or *Octopus*.

12. The morphology of the *Hydrozoa*.

13. The anatomy and physiology of the *Infusoria*.

14. The anatomy and physiology of sponges, *Foraminifera* and *Radiolaria*.

Honours.

In this examination questions will be set at the discretion of the Examiner, who will have regard to the state of Zoological teaching in the country and the means of acquiring information.

Second Stage of Advanced Course of Subject XVII.

(Division of Vegetable Morphology and Physiology.

Questions may be set in all the topics enumerated under the first head, and, in addition, on—

1. The principal modifications in the minute anatomy of the axis in flowering plants.

2. The nature of the parts used for support in climbing plants.

3. The various modes of agamogenesis in flowering plants.

4. The leading facts in the development of the parts of a flower, including that of the pollen, ovule embryo sac, endosperm (albumen), and embryo.

5. The morphology and relations to one another of the parts of the flower and fruit throughout the classes Dicotyledons and Monocotyledons, more especially as exemplified in the following genera :—

Ranunculus, Nymphæa, Capsella, Viola, Stellaria, Malva, Geranium, Ilex.

Eunonymus, Vicia, Rosa, Saxifraga, Lythrum, Epilobium, Anthriscus.

Lonicera, Senecio, Campanula, Erica, Solanum, Plantago, Lamium.

Polygonum, Urtica, Viscum, Fagus.

Orchis, Iris, Potamogeton, Allium, Arum, Lemna, Typha.

Carex, Triticum.

6. The various adaptations by which cross-fertilisation is effected in Flowering plants.

7. The modes by which seeds are diffused.

8. The broad facts of the geographical distribution of Flowering plants.

9. The distinctive characters and origin of the Arctic-alpine flora, and the floras of oceanic islands.

10. The morphology and physiology of the vegetative and reproductive organs in Pinus, Taxus, and Juniperus.

11. The geographical and geological distribution of the genera of Gymnosperms.

12. The morphology and physiology of the vascular cryptogams, more especially with reference to the following types :—

Selaginella, Pilularia, Lycopodium, Equisetum, Polypodium, Lastrea, Osmunda.

13. The morphology and minute anatomy of the Carboniferous Lycopodiaceæ.

14. The morphology and physiology of Mosses and Liverworts as exemplified by Polytrichum (or Funaria) and Marchantia.

15. The morphology and physiology of Algæ as exemplified by—

Fucus, Ceramium, Saprolegnia, Spirogyra, Closterium, Ulva, Volvox, Protococcus, Palmella.

16. The modes of reproduction in Fungi as illustrated by—

Agaricus, Peziza, Penicillium, Peronospora, Mucor, Uredo, Saccharomyces (yeast).

17. The processes of plant nutrition, comparing also their modifications in Fungi, Neottia, and different parasitical plants.

18. The ash constituents of plants and their distribution in th tissues.

19. The influence of heat and light upon plants.

Honours

Questions at the discretion of the examiner, who will have regard to the state of botanical learning in the country, and the means of acquiring information.

ON THE SCIENCE OF WEIGHING AND MEASURING, AND THE STANDARDS OF WEIGHT AND MEASURE *

VII.

Weighing and Measuring Instruments, and their Use

THE instrument universally used for weighing is the balance, with its various modifications. It serves to determine the weight of bodies by comparison with a body of known weight, such as a standard weight. The simplest form of balance is a beam made to vibrate upon a centre or axis of motion, with pans hanging from the extremities of the two arms of the balance. These two pans hold the bodies compared, and their equality or difference of weight can thus be determined.

Balances are of two kinds:—1. Ordinary balances with equal arms, which have the beam suspended by the middle. If an equal-armed balance is accurately adjusted, so that the beam is exactly horizontal when the pans are empty, the beam will also be horizontal, and the balance will be in equilibrium when equal weights are placed in the pans. 2. Balances with unequal arms, in which the beam vibrates upon the centre of motion placed more or less near one of the extremities. In both of these kinds of balance the beams are levers of the first order, the fulcrum upon which the beam vibrates being placed between the power and the weight, that is to say, between the extremities of the beam which support the bodies compared. On the principle of the lever, the power of any weight to move a balance is proportionately greater according as the part of the beam which supports that weight is more distant from the fulcrum or centre of motion of the balance. Hence it follows that the power of the weight to move a balance is in a ratio compounded of the weight itself and of its distance from the centre of motion of the balance. A multiplying or proportionate balance may consequently be constructed for determining the weight of a body placed in the pan suspended from the shorter arm of the bearer, and required to be equal to any multiple of a given unit weight placed in the pan suspended from the longer arm of the beam, termed the weight pan. For this purpose, if the beam be divided into, say three equal parts, and the centre of motion be placed at the first division, one pound placed in the weight pan will form an equipoise with two pounds placed in the other pan, and so on. This principle is greatly extended in larger weighing machines by lengthening the longer arm, through the use of compound levers, so that one pound can be made to form an equipoise with 100 pounds or more.

The ancient Roman balance is perhaps the earliest form of a well-constructed multiplying balance, and corresponds with our modern steelyard. It has been remarked by Sir Gardiner Wilkinson that no instance has been found of the existence of the steelyard before the Roman era. But the principle of its construction was in use amongst the ancient Egyptians, who ascertained the weight of articles suspended from different parts of a scale beam by means of a heavy determinate weight placed in one scale. The Roman balance consists of a determinate weight attached to the longer arm of the beam, and made to traverse along a number of divisions marked upon it. The multiplied power of the traversing weight when resting on the several sub-divisions, as they increase in distance from the centre of motion, is indicated by corresponding figures upon the graduated beam.

The following figure (taken by permission from the "Imperial Journal of Art," vol. i. p. 85) represents an ancient Roman balance of an elegant form, found at Pompeii, and in use A.D. 77. It is described as having the graduated divisions on the longer arm of the beam marked with Roman numerals from X. to XXXX. (probably Roman pounds), and with a V. on the half of each decimal series, the smaller subdivisions being also marked. The inscription on the shorter arm of the beam (shown in a separate and enlarged figure) denotes its having been proved at the Capitol in the 8th of Vespasian Emperor Augustus, and in the 6th Consulate of Titus Emperor Augustus his son. This steelyard is consequently a duly verified standard weighing machine.

For the justness of an equal-armed balance, it is requisite (1) that the points of suspension of the pans from the beam be exactly in the same line as the centre of motion; (2) that these points be precisely equidistant from the centre of motion; (3) that the arms be as long as conveniently may be, in relation to their thickness and the weight they are intended to carry, in other words, consistently with

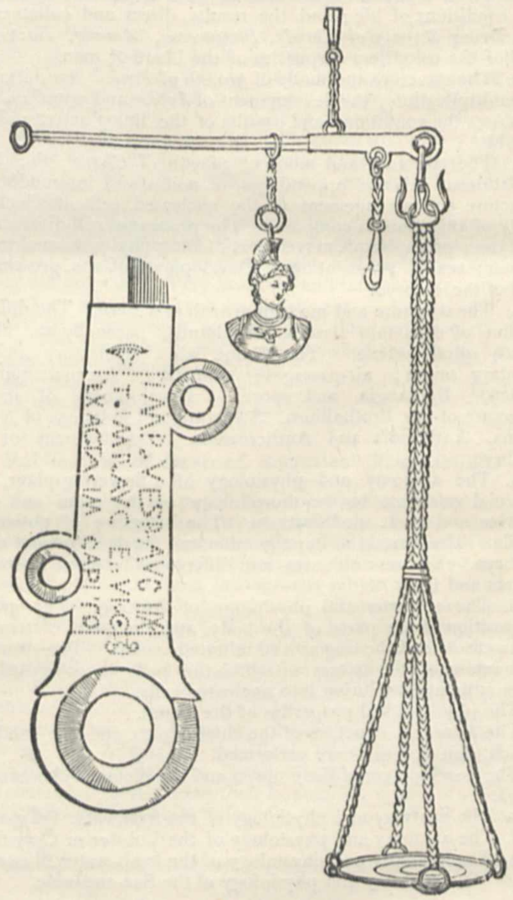

Fig. 15.—Ancient Roman Balance.

the stability of the balance; (4) that there be as little friction as possible at the centre of motion and the points of suspension; (5) that the centre of gravity of the beam be placed a little below the centre of motion.

The fulcrum upon which the beam of a balance rests is formed with a steel knife edge, and the two pans at its extremities are hung upon similar knife edges. In ordinary trade balances, these knife edges, are placed in contact with steel bearings having a spherical curve. But in the practical construction of balances of a high degree of sensibility, such as are required for scientific purposes or for the comparison of standards in which very minute differences of weight are to be determined, there are many circumstances to which attention is requisite, that may properly be neglected in balances used for commercial purposes. In such balances of precision great

* Continued from p. 491.

care is required in the adjustment of the knife edges. They are first made quite sharp, and are then slightly rounded with a fine hone or a piece of buff leather. On the regular form of this rounded edge, the excellence of the action of the balance very much depends. The central knife edge rests upon an agate or polished steel plane, whilst the two pans are suspended from agate or steel planes bearing upon the knife edges at the ends of the beam. In order to preserve the nice adjustment of the knife edges, they are never allowed to rest upon their bearings, except when weighings are made. At all other times, the beam and pans are separately supported upon a brass frame attached to the column of the balance, but moveable in a vertical direction upon it. When required to be put in action the support is gradually lowered by means of a lever handle, and the knife edges are brought upon their bearings.

The principal cause of discordances in the results of successive weighings with a balance of precision arises from the risk of the knife-edges not being brought again to exactly the same position on the plane bearings, after the balance has been stopped and again set in action. The most perfect balance is that which varies least in the points of contact between the knife-edges and their bearings during successive weighings. For the attainment of this very important requirement, the supporting frame is furnished at each of its extremities with two pins terminating in cones and made to fit exactly into corresponding conical holes in the plane bearings, at each of the extremities of the beam. The pins and holes are in a line normal to the axis of the beam. The points of these four cones are all in the same horizontal plane. As the movement of the supporting frame in a well-constructed balance of precision is always in the same vertical line, being guided by a vertical rod fitted to a cylindrically drilled hole in the column of the balance, the knife-edges and their bearings are always brought into contact in the same relative positions. Balances of precision are always enclosed in plate glass cases, with a view both to their preservation, and to keep the balances as far as possible from being affected in their action by draughts of air, alternations of temperature, &c.

As to the theory of the relative positions of the centre of motion and the centre of gravity of a balance, it is to

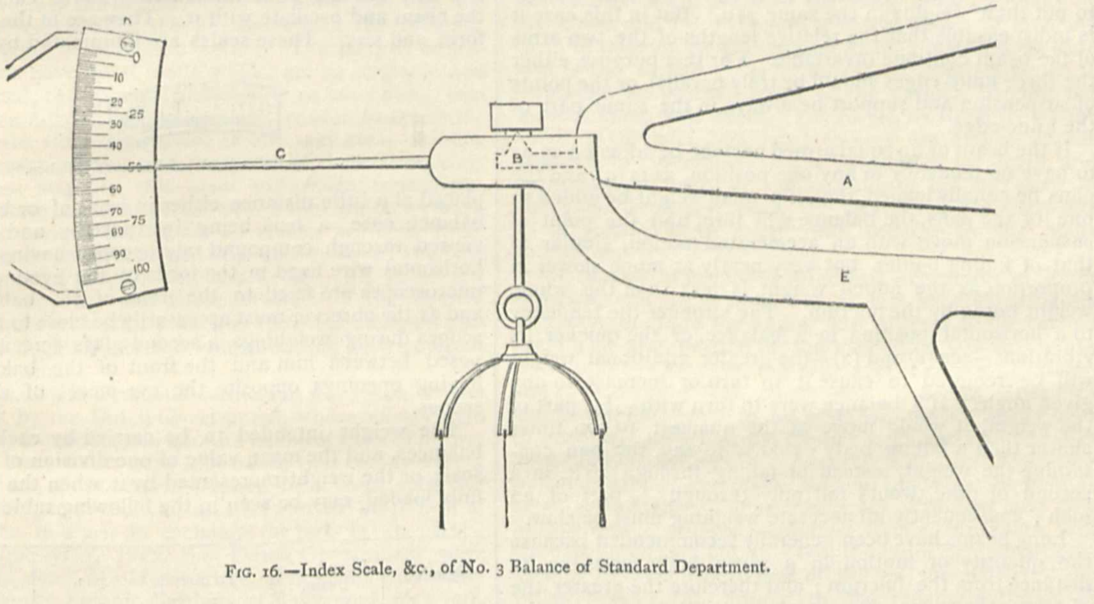

FIG. 16.—Index Scale, &c., of No. 3 Balance of Standard Department.

be remarked, (*a*) If the fulcrum be placed in the centre of gravity of the beam, and the three edges be all in the same right line, the beam of the balance will have no tendency to one position more than another, but will rest in any position in which it may be placed, whether the pans be suspended to it, or not, and whether the pans be empty or equally loaded. (*b*) If the centre of gravity of the beam, when level, be immediately above the fulcrum, it will upset with the smallest action; that is to say, the end which is lowest will descend; and it will descend with the greater velocity, according as the centre of gravity is higher, and the points of suspension less loaded. (*c*) But if the centre of gravity of the beam be immediately below the fulcrum, the beam will not rest in any position but when level; and if disturbed from that level position, it will vibrate, and at last come to rest in a horizontal position. Its vibrations will be quicker, and its tendency to the horizontal position stronger, the lower the centre of gravity, and the less the weight upon the points of suspension.

Again, as to the relative position of the central knife edge, which constitutes the fulcrum of the beam with the line joining the two outer knife edges, which form the points of suspension, it is further to be remarked, (1) If the fulcrum be below the line joining the points of suspension, and these be loaded, the beam will upset, unless prevented by the weight of the beam tending to produce a horizontal position, as shown in (*c*). In such case, small weights will form an equipoise. In case of (*a*), a certain exact weight will rest in any position of the beam; and all greater weights will cause the beam to upset, as in (*b*). (2), If the fulcrum be above the line joining the points of suspension, the beam will come to its horizontal position, unless prevented by its own weight, as in (*b*). (3) If the centre of gravity be nearly in the fulcrum, all the vibrations of the loaded beam will be made in lines nearly equal, unless the weights be very small, when they will be slower. The higher the fulcrum the quicker will be the vibrations of balances, and the stronger the horizontal tendency.

It is thus evident that the nearer the centre of gravity of the beam is to the centre of motion, the more delicate will be the balance, and the slower the vibrations. The tendency to a horizontal position is therefore increased by lowering the centre of gravity, in which case it will also require a greater additional weight to cause it to turn or incline to any given angle, and it is therefore less sensible with a greater load. The fixing of the centre of motion in a balance is consequently of peculiar importance, for on this depends the ease with which it will be affected by a smaller weight, and the readiness with which the beam will return to a horizontal position. And it will be seen that the best position of all is that in which the centre of motion is a little above the centre of gravity. Even in this, it should be proportioned to the distance of the weights from the fulcrum, and the amount of the load, which can only be attained in different beams by practice and experience. In order to regulate the centre of gravity in balances of precision, they are made to carry a small weight either over or under the centre of motion, which is moveable by means of a screw.

From what has been said it would appear that if the arms of a balance be unequal, weights which form an equipoise will be unequal in the same proportion. But although for many purposes the equality of the arms of a balance is advantageous, yet a balance with unequal arms will weigh just as accurately as one with equal arms, provided the standard weight itself be first counterpoised, then taken out of the pan, and the weight to be compared be substituted and adjusted against the counterpoise. Or when proportional quantities only are required, they may be weighed against standard weights, taking care always to put these weights in the same pan. But in this case it is indispensable that the relative lengths of the two arms of the beam continue invariable. For this purpose, either the three knife-edges should be truly parallel, or the points of suspension and support be always in the same part of the knife-edge.

If the beam of an equal armed balance be adjusted so as to have no tendency to any one position, as in (*a*), and the pans be equally loaded, then if a small weight be added to one of the pans, the balance will turn, and the point of suspension move with an accelerated motion, similar to that of falling bodies, but very nearly as much slower in proportion as the added weight is less than the whole weight borne by the fulcrum. The stronger the tendency to a horizontal position in a balance, or the quicker its vibrations—see (*c*) and (2)—the greater additional weight will be required to cause it to turn or increase to any given angle. If a balance were to turn with $\frac{1}{10000}$ part of the weight, it would move at the quickest, 10,000 times slower than a falling body; that is to say, the pan containing the weight, instead of falling through 16 ft. in a second of time, would fall only through $\frac{1}{50}$ part of an inch; consequently all accurate weighing must be slow.

Long beams have been generally recommended because the quantity of motion in a given body varies as its distance from the fulcrum; and therefore the greater the distance, the most distinguishable will be the motion arising from any small difference between the weights compared. On the other hand, there are certain advantages in the quicker angular motion, greater strength, and less weight of a short beam.

The pans of a balance should be suspended in such a manner that in all positions the corresponding cords or rods may be parallel to one another; else the weights, though equal, will not be in equilibrium.

In ordinary commercial balances, the preponderance of either pan is indicated by a slender rod attached to the beam immediately over its centre of motion in a line perpendicular to the axis of the beam, and moveable freely between the two forks of the handle. It is called the tongue of the balance, and the degree of preponderance of either pan is shown by the greater or less deviation of the tongue from its normal vertical position. In balances of precision, the index is a longer needle-rod, fixed either in a line perpendicular to the axis of the beam, and below its centre of motion, or in a line in continuation of its axis. In both cases the pointer moves along a graduated index. But an index placed perpendicular to the beam affects its equilibrium when turning from its horizontal position; the momentum of the index being measured by its weight multiplied with the distance of its centre of gravity from a line perpendicular to the horizon. The error thence arising may, however, be corrected by continuing the index-rod or counterpoising it, on the opposite side of the beam.

The finest balances of the Standards Departments have the index pointer in the line of the axis of the beam, as shown in Fig. 16, which represents the left-hand side of the balance, the right-hand side being similarly furnished with a pointer and index scale.

This is the medium size of six of the finest balances of the Standards Department, constructed by Mr. Oertling. For all weighings of standards requiring special accuracy, the highest and lowest points reached by the needle in each oscillation of the balance are read on the index scale through a telescope fixed at about 5 ft. distance, by which means each reading can be satisfactorily taken by estimation to one-tenth of a division of the scale.

Another balance of the Standards Department is one constructed by Barrow, and used by Prof. Miller for all his weighings during the construction of the new Standard pound. The knife-edges work upon quartz planes. Index scales marked on a thin and nearly transparent slip of ivory are fixed immediately above each end of the beam and oscillate with it. They are of the following form and size. These scales are illuminated by a candle

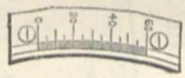

FIG. 17.—Index Scale of Barrow's Balance.

placed at a little distance either in front of or behind the balance case, a lens being interposed; and they are viewed through compound microscopes having a single horizontal wire fixed in the focus of the eye-piece. The microscopes are fixed to the front of the balance-case, and as the observer must necessarily be close to the microscopes during weighings, a second glass screen is interposed between him and the front of the balance-case, having openings opposite the eye-pieces of the microscopes.

The weight intended to be carried by each of these balances, and the mean value of one division of the index scale, or the weight represented by it, when the balance is fully loaded, may be seen in the following table:—

Balance.	Length of Beam.	To carry in each pan.	Mean value of 1 div. of Index Scale.
	In.	Avoir. Troy.	Grains.
No. 1	36	56 to 14 lbs., or 500 to 200 oz.	0·15
No. 2	24	7 to 2 lbs., or 200 to 20 oz.	0·02
No. 3	16	1 lb. to 2 oz. or 20 to 2 oz.	0·0015
No. 4	10	1 oz. and under, 1 oz. and under	0·0008
No. 5	10	30 gr. and under.	0·0002
No. 6	20	1 kilo. and under.	0·0015, or 0·1 mgr.
Barrow's	...	1 kilo. and under.	0·005, or 0·3 ,,

There is another much larger balance which was originally constructed for weighing the contents of water of the Imperial Standard bushel, the total weight in each pan being nearly 300 lbs. The beam of this balance is of mahogany, 67¼ in. in length. With a full load, the mean value of 1 div. of the index-scale is 0·4 grain. This balance, like the other, is enclosed in a large plate-glass case.

In all these balances, the value of a division varies from time to time according to the weight in the pans, the condition of the balance, the state of the atmosphere, &c., and in all very accurate weighings it is desirable to determine the value for each comparison, by an additional weighing, after a very small weight, accurately verified and equal to a few divisions only of the balance, has been added to one of the pans, so that its effect on the reading of the index scale may be noted. The above stated values indicate nearly those found when the balance is in good working condition, and fairly weighted.

All these balances, when in equilibrium, will turn with a very small additional weight, equal to the value of two or three divisions, placed in one of the pans. They are exceedingly sensitive, for the sensibility of a balance is to be measured by the least amount of additional weight placed in either pan that is sufficient to turn the index-pointer from its normal position, when the balance is in equilibrium, and by the greatest amount of deviation from the normal position which is produced by a very small difference in the weights.

H. W. CHISHOLM

(*To be continued.*)

CINCHONA CULTURE*

FEW subjects have been so frequently before pharmaceutical readers during the past ten or fifteen years as the efforts of the governments of Holland and Great Britain to introduce the various species of Cinchona into their respective colonies. It would be hardly possible to overrate the importance of the enterprise, and it is one that interests alike the pharmaceutist, the botanist, and the votary of economic science. The records of progress which have been made public are so scattered and unconnected, the opinions and reports so conflicting, that it has been difficult for the general reader to retain the thread of the story or to arrive at any very clear estimate of the present position and prospects of the undertaking. The earliest steps in this great experiment in acclimatisation date back to a period before that which we have had under review, but so far as results are concerned, the subject is one which pertains essentially to the past few years, and I propose to place before you, in as few words as may be, and unencumbered by the controversial matter with which its literature abounds, an outline of the beginning of the enterprise and of its present practical aspect.

The initiative in Cinchona cultivation was taken, as you well know, by the Dutch Government, whose efforts were directed to its introduction into the Island of Java. The first Cinchona trees which were sent out to that colony were a few specmens of *C. Calisaya* † raised from seeds collected by M. Weddell in Bolivia, and forwarded by a firm of nurserymen in Paris in exchange for rare Javan plants. In the same year, 1852, the Dutch Government were induced to send M. Hasskarl, a gentleman previously attached to the Botanic Gardens at Buitzenorg, on a mission to South America, for the purpose of collecting plants and seeds. During the two years following M. Hasskarl pursued his labours, and succeeded in forwarding consignments from some parts of Peru, the Cinchona districts of Bolivia being for the most part closed against him; and his efforts were supplemented as to the New Granada species by the assistance of Dr. Karsten. The resulting collections were sent in part direct to Java, and the remainder to Amsterdam for re-shipment. I need not dwell on the mishaps and disappointments inevitable in so new and difficult an enterprise—it is sufficient to note that within three or four years, that is by the middle of 1856, upwards of 250 plants, almost exclusively of two species, *C. Pahudiana* and *C. Calisaya*, were flourishing in the Java plantation as the outcome of the expedition. In the same year, with wise forethought, an accomplished chemist, Dr. De Vrij, was sent out to conduct chemical observations on the growing barks.

We may pass over the long series of troubles that attended the early efforts of those in charge of the trees, the ravages of insects, the destruction of young plants by rats, the devastation committed by wild cattle and rhinoceroses, and, above all, the difficulties dependent on climate, which eventually necessitated the transplantation of nearly the whole of the trees from the locality first chosen, on the north side of the mountain range, to one with a southern aspect. We will pass on, I say, to the year 1863, and we shall find that the total number of Cinchona trees in Java was then 1,151,810. Of these about 99 per cent. were of the species know as *C. Pahudiana*, the remainder comprising about 12,000 of *C. Calisaya* and trifling numbers of four other species. This proportion was unfortunate, for the bark of *C. Pahudiana* was found to be deficient in alkaloids, and therefore supposed to be valueless, and by decrees dated 1862 and 1864 its further culture was ordered to be forthwith stopped.

We may now turn to the steps taken by the British Government in the same direction.

Dr. Ainsley, in his work on "Materia Medica," was perhaps the first to suggest the idea of the acclimatisation of the Cinchona in India, and, as early as 1839, Dr. Forbes Royle especially indicated the Neilgherry and Silhet mountains as eligible for the experiment. Appeals were subsequently made to the East India Company by Mr. Grant and Dr. Falconar, with the object of inducing them to take up the matter, and in 1852 instructions were sent to the British consular agents in South America to endeavour to procure seeds of the various species, but without much real effect. Dr. Royle, as Reporter on the Products of India, continued to urge the subject on the attention of Government up to the time of his death, and eventually, in 1859, at the instance of his successor in office, Dr. Forbes Watson, the services of Mr. Clements R. Markham were called into request by the home authorities.

Mr. Markham proposed a fourfold expedition to South America, and his scheme was at last sanctioned by the Secretary of State for India, and ordered to be carried out. The first portion of the expedition was directed ta Bolivia and Caravaya, the region of *Cinchona Calisayo* and *C. micrantha* (var. *Boliviana*). Secondly, Huanuco and Huamalies were to be searched for *C. nitida* and *C. glandulifera* Thirdly, Cuenca and Loxa in the Republic of Ecuador for *C. Chahuarguera*, *C. Uritusinga*, and *C. Condaminea*; and lastly, New Granada as the habitat of *C. pitayo* and *C. lancifolia*. Mr. Pritchett and Mr. Spruce were appointed coadjutors to Mr. Markham, and the expeditions set out in 1859, the latter gentleman proceeding to the northern part of Bolivia, the district of the yellow barks; Mr. Spruce to the mountain region of Chimborazo, in quest of red cinchonas; Mr. Pritchett taking the grey bark forests of Huanuco, in the north of Peru. The perils encountered by these travellers, the hardships they endured, the disappointments they suffered, form a chapter in the history of travel. But illness and privation, bad roads, and even native jealousies left unaffected the general success of the expedition, and though, unfortunately, the plants collected at great risk by Mr. Markham, including many of the best species of Bolivia, perished in the Red Sea in their transit to India, leaving no survivors, it is to the work accomplished by these three enthusiastic labourers that we owe the basis of our present Cinchona plantations. In 1860, the Ootamacund station was established, and the following year the number of young Cinchona trees was reported to be 1,128. Under the excellent care of Mr. McIvor these had been increased in 1863, the date to which I have brought my account of the Java plantations, to 248,166.

It is no part of my purpose to enter into minutiæ of history, nor to do more than associate with the first steps in Cinchona culture the names of Messrs. Hasskarl and Markham, Spruce, and Pritchett as travellers, those of Dr. De Vrij and Mr. John Eliot Howard as advisers in technical details, and more recently, Messrs. McIvor and

* From the Address delivered at the Pharmaceutical Conference, Bradford, by Henry B. Brady, F.L.S., F.S.C., President.

† My friend, J. E. Howard, F.L.S., to whose kind revision subsequent paragraphs owe any scientific value they possess, tells me that, accuratel speaking, these were *C. Calisaya*, and var. *Josephiana*.

Broughton, who have been conspicuous, so far as India is concerned, in the rapid development of the enterprise.

The efforts of our own Government have not been confined to India, but localities have been sought in other parts of the world where natural conditions seemed to favour the chance of success in the introduction of quinine-yielding trees, and at the time I speak of (1863) there were under the care of Mr. Thwaites in Ceylon upwards of 20,000 young Cinchona plants. Jamaica also had made a successful beginning, and the authorities of several European countries were considering how far their respective colonies might be utilised to the same end, though but little decided action beyond what I have stated had been taken.

The ten years that have intervened need not detain us, but having noticed the origin, we will turn at once to the practical aspect of the subject at the present time.

The latest official return places the number of Cinchona trees in cultivation in the Island of Java at two millions.

I can find no published account of the exact extent of the British plantations at the present time. My latest information I owe to the kindness of C. R. Markham, F.R.S., of the India Office. It is contained in the Parliamentary Blue-book of August 1870, and refers only to the Madras and Bengal Presidencies. This gives the total number of Cinchona plants growing on the Neilgherries in January of that year at 2,595,176, of which nearly one-half (1,143,844) were permanently planted out.* The number at Darjeeling in the Bengal Presidency in March 1870 is stated at 2,262,210, of which a million and a half were in permanent plantations.

Of the extent of the plantations in Ceylon and Jamaica I know nothing, but reports from time to time state that they are prospering. It is needless to refer to the experiments in cultivation in the south of Europe, the Caucasus, Brazil, the Philippines, or Australia, as these are not yet sufficient in extent to have any practical significance.

The relative value of the bark produced by the various species and varieties of Cinchona is a question that has received close attention, and perhaps cannot be considered settled until something more like uniformity in the subdivision and nomenclature of the genus prevails. Plants regarded as merely varieties of the same species yield widely differing proportions of alkaloids, and the subject is further complicated by considerations as to the possible effects of cultivation and of different climatal conditions. . . . .

The barks now being produced in the Dutch and British colonies are referrible to five species, viz.:—

C. Calisaya, of which, as I have said, only a small proportion realises expectation in its yield of quinine;

C. Hasskarliana (called a hybrid), which appears to be of little value in respect of alkaloids;

C. Pahudiana, deficient in the same particulars, but producing a bark which finds a ready market for pharmaceutical purposes;

C. officinalis, which, in British India,* appears to be the most generally satisfactory; and

C. succirubra, which, notwithstanding certain exceptional samples, has not turned out altogether well. . . . .

I can say little about the West Indian plantations as to extent, but the quality of the bark they produce is encouraging. Mr. Howard reports that the chemical examination of barks from Jamaica is "highly satisfactory as regards the prospects of Cinchona culture in that island."

Various questions are still pending:—the influence of manures on the chemical constituents of the trees, the various methods of removing the bark from the tree, and the encouragement of renewal by the processes of stripping and mossing, and many others of like importance, the solution of which must be left to time, and need not occupy our consideration here.

* Since this was written I have received a copy of a return which is believed to represent the actual number of Cinchona trees in the Government plantations in the Neilgherries at the present time. It shows an increase of 12,330 "planted out," and is as follows:—

Crown barks (*C. officinalis*)	508,878
Red barks	579,938
Yellow barks	33,850
Grey barks	28,759
Other species	4,749
	1,156,174

In addition to these it must be recollected that the Government had up to 1870 distributed upwards of 178,000 trees from the Neilgherry nurseries, as well as nearly three hundred ounces of the seeds of various species, to private individuals disposed to plant on their estates. After all, when the experimental stage of such an undertaking is over, private enterprise would seem to be its safest basis. A Parliamentary paper on the progress of India in 1872, just issued, gives the total number of plants in the Neilgherry plantations as 2,639,285, but this probably includes the very young trees still in nurseries. I have no particulars beyond what appear in a paragraph in the *Times*.

* This limitation is at present necessary. Dr. De Vrij's late paper on Jamaica barks ("Pharm. Journal," August 16, 1873) shows the produce of *C. officinalis* in that island to be very deficient in quinine, inferior indeed to *C. Pahudiana*, whilst a still later communication confirms Mr. Howard's opinion as to the richness of Indian-grown specimens.

DONATI

SCIENCE, and more particularly astronomy, has recently sustained a serious loss in the death of Prof. G. B. Donati, Director of the Royal Observatory of Arcetri, near Florence, and Professor of Astronomy in the Royal Institution of that city.

On his return from Vienna, where he had represented Italy at the International Meteorological Congress, he was seized by a severe attack of Asiatic cholera, to which in a very short time he fell a victim, dying at his villa near the Observatory, on the morning of the 20th of September last, being only forty-seven years of age. He was born at Pisa in 1826. In 1852 he began his astronomical career at the Observatory of Florence, and by his talents, his attainments, and his indefatigable industry, rapidly gained the esteem and admiration of the learned, attaining a well-merited fame, not so much by the discovery of new comets—among which the most remarkable was that of 1858, to which he bequeathed his name—as by the important observations which he made and published. Of these we need only mention his observations on the study of the spectra of the stars, by which work he successfully inaugurated in 1860 one of the most important branches of physical astronomy, namely, the spectroscopy of celestial bodies.

In 1864 he succeeded Prof. G. B. Arnia as Director of the Observatory, after which much of his time and energy were devoted to the establishment of an observatory for Florence and for Italy, which should be completely adapted to the present exigencies of Science, both as regards astronomy and terrestrial physics.

He was in no way discouraged by the serious difficulties of this undertaking, but, inspired by a true love of Science, he overcame them all, insomuch that in a short time, under his active and keen-sighted superintendence, the new observatory was erected on the hill of Arcetri; an observatory which, by the excellence of its position, as well as by the convenience and solidity of its construction, has guaranteed for astronomy and terrestrial physics the most important advantages in every branch of observation.

The observatory was already in working condition, and an important series of observations had been commenced when Science was robbed, by a premature death, of one of her most valued worshippers, who was thus cruelly cut off just as he had entered upon a brilliant career, in which, had he lived, he would certainly have greatly augmented his fame, and shed glory on the Observatory of Arcetri.

Prof. Donati had already commenced a series of notes from the new observatory by the recent publication of some most careful observations of his own on the luminous phenomena of the great Polar aurora of the 4th to the 5th of February, 1872; and we had hoped that other important observations by the illustrious Italian astronomer would, to the great advantage of Science, have been published in the future Notes issued from that scientific establishment.

NOTES

WE regret to have to record the death of two notable men this week. The one is Sir Henry Holland, Bart., M.D., F.R.S., &c., who died on Tuesday, the 28th inst., at the age of 85 years. Sir Henry had caught cold on returning from Paris, which, in spite of his wonderfully robust constitution, proved too much for the veteran traveller. The other is Mr. Albany Hancock, the distinguished anatomist, who died on the 24th inst. He was a medallist of the Royal Society, though not a Fellow. We hope shortly to give memoirs of both men.

SIR ROBERT MACLURE, C.B., so well known in connection with Arctic discovery, died on the 17th inst., at the age of 66.

SIR SAMUEL BAKER was announced to appear before the Geographical Society on Monday first, and give an account of the geography of the country he has lately visited; but we regret very much to hear that illness will prevent him from fulfilling this and other engagements. He has been suffering from inflammation of the lungs.

PROF. FLOWER, we regret to hear, has been compelled to spend the winter in Egypt on account of the state of his health.

DR. J. EMERSON REYNOLDS has been elected Professor of Chemistry to the Royal College of Surgeons in Ireland. The College of Surgeons is to be congratulated on this appointment. Dr. Reynolds will, we believe, still hold his appointment of Keeper of the Minerals and Professor of Analytical Chemistry to the Royal Dublin Society.

MR. JOHN STUART MILL has left his herbarium of European plants to Kew.

WE are informed that the authorities of the Jardin des Plantes, of Paris, have acquired the valuable collection of books on Natural History belonging to the late M. J. Verreaux, and also his private collection of Sugar birds (*Nectarinidæ*), which includes many unique specimens.

IN connection with St. John's College, Cambridge, there will be offered for competition an Exhibition of 50*l*. per annum for proficiency in Natural Science, the Exhibition to be tenable for three years in case the exhibitioner have passed within two years the previous examination as required for candidates for honours: otherwise the exhibition to cease at the end of two years. The candidates for the Natural Science Exhibition will have a special examination (commencing on Friday, December 12, at 9 A.M.) in (1) Chemistry, including practical work in the Laboratory. (2) Physics, viz., Electricity, Heat, Light. (3) Physiology. They will also have the opportunity of being examined in one or more of the following subjects, (4) Geology, (5) Anatomy, (6) Botany, provided they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, whereof one at least must be chosen from the former group. It is the wish of the Master and Seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the Classical or Mathematical subjects. Candidates must send their names to one of the tutors fourteen days before the commencement of the Examination. The tutors are Rev. S. Parkinson, D.D.; Rev. T. G. Bonney, B.D., and J. E. Sandys, Esq., M.A.

THE Royal Horticultural Society of Tuscany has announced an International Horticultural Exhibition to be held at Florence from May 17 to 25, 1874, and has also issued the programme of an International Botanical Congress to be held on three days during the Exhibition. A very large number of prizes, including 100 gold medals, are offered for collections of plants or single plants, which are included in 248 different classes; and among other objects for which prizes may be obtained are bouquets, botanical drawings, models, garden tools and ornaments, garden structures, manures, herbaria, specimens of timbers, &c. The Congress will be opened by the president, Prof. Parlatore; excursions to the neighbourhood of Florence and the principal gardens will be inaugurated, &c.; and among the subjects proposed for discussion, *inter alia*, are the following:—On the duration of dormant vitality in plants, and on the means of restoring it; on the causes of the movements in leaves; on the acclimatisation of perennial plants; on the analogy between the reproductive organs of flowering and (so-called) flowerless plants; on the general occurrence, or otherwise, of cross-fertilisation, and on the durability of the vitality of pollen; on the nature and functions of the gonidia of lichens: on the nature and origin of Bacteria; on the possibility of establishing rules for a rational distinction between the groups called species, race, variety, &c.; on the value to be set on the determination of fossil plants, &c.; on the character and origin of Alpine floras, and especially on the causes which have limited their extension. The Horticultural Society of Tuscany seem determined to do everything they can to attract visitors, who must send their names to the president or secretary at the Musée Royale de Physique et d'Histoire Naturelle at Florence; and altogether botanists and horticulturists seem likely to have a good time of it.

AN effectual remedy for the devastations committed on the vines by the *Phylloxera vastatrix* is said to have been discovered by MM. Monestier, Lautand, and D'Ortoman, of Montpellier. It consists in placing in the ground, close to the root of the infected plant, an uncorked tube containing about 2 oz. of bisulphide of carbon. The vapour from the bisulphide in a short time permeates the whole of the ground about the root; the vapour is not, like the liquid itself, injurious to the plant, but is immediately fatal to the insect. Care must be taken not to spill any of the liquid on the roots of the vine.

THE following subjects for prizes to be awarded in 1874 hav been proposed by the Batavian Society of Experimental Philosophy:—1. To discover if there exists in the molecular state ot bodies, modifications other than those caused by temperature, which are such as to give for the same body, different spectra. The Society wishes that this inquiry should bear chiefly on the magnetic condition of bodies. 2. To find out by new experiments if the vapour of water exercises on radiant heat an absorbant effect much more powerful than dry atmospheric air, as Mr. Tyndall maintains; or if there exists no difference in this respect between dry and moist air, as M. Magnus maintains. The Society desires that the new experiments which it asks for be conclusive and enable it to decide between the two opinions. 3. To determine what influence the pressure which is put upon an electrolyte has on electrolysis, and how far in this case is the principle of conservation of energy confirmed. It is wished that this inquiry bear on three liquids at least, to be chosen by the competitor. 4. To determine the resistance of the liquid amalgams of zinc and gold to the galvanic current. Six at least of each of these amalgams, in various proportions, ought to be examined. 5. A prize is proposed for new experiments which will enable a certain decision to be come to on the opinion advanced by M. Gaugain as probable, viz. that voltaic electricity is propagated by matter, while induced electricity is propagated by ether.

THE German expedition for the exploration of the Libyan desert is expected to start from Europe about the end of November, and from Egypt early in December, and it is thought that the first reports may accordingly be looked forward to about Christmas. The leader of the expedition is Dr. Gerhard Rohlfs.

FATHER SECCHI, we are glad to see, has received permission from the Italian Government and Cardinal Antonelli to remain at the Royal College of Astronomy.

AMONG the societies concerning which we have received information since the publication of our list last week, is the Working Men's College Field Club, of which Prof. Flower is president. It meets in the Museum of the College in Great Ormond Street, has been in existence only five months, but appears from a reports before us to be in good working trim. It has meetings at which papers are read, courses of lectures by well-known scientific men, and several field-days each month. These field-days seem generally to be Saturday and Sunday, and we only wish that working-men generally put their Saturdays and Sundays to such an excellent recreative use.

WE congratulate the Sunday Lecture Society on the excellent beginning, to be made next Sunday, of their winter course of lectures. Dr. Carpenter, we see, is to give a series of two lectures on the brain; and we think the society ought to consider whether it would not be advisable to have more connected series of lectures than they have hitherto had.

IN a final letter to yesterday's *Daily Telegraph*, Mr. George Smith concludes the account of his Assyrian Expedition. Altogether both Mr. Smith and the *Telegraph* are to be congratulated on the results of the enterprise.

THE following "Science Lectures for the People," are announced to be delivered at the Memorial Hall, Manchester; the Hulme Town Hall being now required for other purposes:—Wednesday, Oct. 29, "Polarised Light," illustrated by experiments in the electric light, by Wm. Spottiswoode, F.R.S., Treasurer of the Royal Society. Nov. 5, "How Flowers are Fertilised," by A. W. Bennett, M.A., Lecturer on Botany, St. Thomas's Hospital, London. Nov. 12, "On Parasites and their Strange Uses," profusely illustrated, by T. Spencer Cobbold, M.D., F.R.S. Nov. 26, "Animal Mechanics," illustrated by experiments with the electric light and the oxy-hydrogen lantern, by S. M. Bradley, F.R.C.S. Dec. 3. "The Senses," by Prof. Croom Robertson. Dec. 10, "On Muscle and Nerve," illustrated by experiments with the electric light and the oxy-hydrogen lantern, by Prof. Gamgee, F.R.S. Dec, 17, "The Time that has elapsed since the Era of the Cave Men of Devonshire," by Wm. Pengelly, F.R.S.

THE French Association, as is known, is to meet at Lille in 1874. Among the many towns which desire to be favoured with its presence in 1875 is Nantes, the Municipal Council of which has already devoted 10,000 francs to defray the preliminary expenses of the session, should it take place there.

ACCORDING to *La Nature* the volcano of Mauna Loa, in Hawaii, is at present in full eruption.

A MICROSCOPIC SOCIETY has recently been founded at Melbourne.

LAST Thursday the whaler *Erik* arrived in Dundee, having on board R. W. D. Bryan, who was astronomer to the *Polaris* Expedition; B. Manch, seaman; and J. W. Booth, fireman. All the men were in excellent health. On Friday the *Ravenscraig* arrived at Dundee, having on board one of the boats ingeniously constructed by Mr. Chester, in which the castaways effected their escape from their winter quarters. It is about the size of a whaling-boat, and somewhat similarly shaped.

THE *Journal of the Society of Arts* gives, from the annual report published by the Minister of Public Education, the following particulars respecting education in Italy during the scholastic year 1872-73:—The number of students registered at the Royal Universities was 5,614, and in addition to this number 1,333 persons were allowed to attend the course of lectures, making in all 6,497. At the Universities of Camerino, Ferrara, Perrugia, Urbino, 284 students and 22 non-students, in all 806, attended the course of lectures. At the Royal Institute of high studies at Florence the number of students was 214. The Literary and Scientific Academy of Milan numbered 26. At the Royal School of Application for Engineers the number of students was 173, and at that at Naples 185. The Technical Institute of Milan was attended by 209 students, and the Normal School of Pisa by 41. 295 students were registered at the schools of Veterinary Science of Milan, Turin, and Naples. The royal lyceums are 79 in number, with 4,228 pupils; the royal gymnasiums 104, with 8,462 pupils. In the royal colleges, which are 26 in number, there were 2,208 pupils. The following schools received subsidies from Government:—32 in Piedmont, 67,290 francs; 19 in Lombardy, 49,810 fr.; 10 in Venetian provinces, 16,550 fr.; 24 in Emilia, 52,800 fr.; 14 in Tuscany, 31,200 fr.; 17 in Marshes, Umbria, and Roman provinces, 20,800 fr.; 54 in Neapolitan provinces, 90,350 fr.; 5 in Sicily, 6,200 fr. The number of elementary schools throughout the kingdom was 41,713 (being 3,413 more than were opened during the previous year). Of this number 21,353 were for boys, and 16,280 for girls. 33,556 were public and 8,157 private schools. The number of pupils attending those schools during the scholastic year 1872-73 was 1,723,007, showing an increase of 145,853 on the number of the previous year; of this 960,517 were boys, and 762,490 girls. The total number of pupils attending the public schools was 1,545,820, and those of the private schools 177,187. The total number of teachers in these schools was 43,420, being an increase of 3,102 on the number of the previous year. Of these 23,212 were teachers in the boys' schools, and 20,211 in the girls' schools; the public schools being conducted by 34,309 teachers, and the private by 9,114.

WE have received the Catalogue of the publications of Gauthier-Villars, of Paris, for April, May, and June of this year. It contains the publications of most of the scientific societies of France, beside a number of original works in mathematics, physics, engineering, &c., which recommend it to the attention of scientific men. A few more foreign catalogues have also come to hand, which we would recommend to those who wish to know what is being published on the Continent; no doubt the publishers would be glad to send these catalogues to any one asking for them:—Catalog des Antiquar. Bücherlagers von Fidelis Butsch Sohn (Augsburg, 1874, *sic.*); A catalogue of works in Anatomy and Physiology, and Medicine generally, which belonged to the late Dr. Fahle, of Altona (T. O. Weigel, Leipzig); the same bookseller has sent a Catalogue of standard works in all departments of Science.

WE are glad to see that the *Quarterly Journal of Education*, which is shortly to become a monthly, has opened its columns to a correspondence upon questions relating to science-teaching.

WE have received a separate reprint from the "Proceedings of the Geologists' Association" of Mr. D. C. Davies' valuable paper on "The Overlapping of the Several Geological Formations of the North Wales Border."

THE United States Signal Service has recently constructed a telegraph line to the summit of Pike's Peak, in Colorado, which is said to be the highest point reached by any line in the United States, or perhaps in the world. The height is said to exceed 11,000 ft. Regular reports as to the weather are to be sent to Washington three times daily.

THE additions to the Zoological Society's Gardens during the past week include an American Cross Fox (*Canis fulvus*), a Golden Eagle (*Aquila Chrysaëtus*), and a Virginian Eagle Owl (*Bubo virginianus*), from North America, presented by Capt. D. Herd; a Mexican Deer (*Cervus mexicanus*), from Porto Rico, presented by Mr. W. Isaacson; two Sand Badgers (*Meles ankuma*), from Japan, presented by Lieut. Hon. A. C. Littleton; a Black-eared Marmoset, (*Hepale penicillata*), from Brazil, presented by Mr. C. Hawkshaw; a Spotted Hyæna (*Hyæna erocuta*), and two Bronze-winged Pigeons (*Phaps chalcoptera*), born in the Gardens; two Rheas (*Rhea americana*), from S. America, deposited; two Chilian Tinamous (*Rhynchotus perdicarius*), three Banded Tinamous (*Crypturus noctivagus*), and two Obsolete Tinamous (*C. obsoletus*), from S. America, received in exchange.

*ORIGINAL RESEARCH AS A MEANS OF EDUCATION**

II.

IT is the greatest possible mistake to suppose—as, unfortunately, many yet do—that a scientific education unfits a man for the pursuits of ordinary professional or commercial life. I believe that no one can be unfitted for business life or occupations by the study of phenomena, all of which are based upon law, the knowledge of which can only be obtained by the exercise of exact habits of thought, and patient and laborious effort. I dare say many who have had a scientific education make bad men of business, but so do many who have not had such an education; it is not the scientific education which has spoilt them. Even more directly does the value of scientific education bear upon professional and manufacturing life. The medical man's success depends mainly upon the exercise of faculties which are pre-eminently called forth, and strengthened in original scientific investigations. The manufacturer who aspires to something more than following the rule-of-thumb work of his predecessors, requires exactly these habits of mind which are developed by original research. If the brewer, the calico-printer, the dyer, the alkali-maker, the metallurgist wish to make any advance of their own in their respective trades, they cannot do so without the exercise of powers which can only be gained by the prosecution of original inquiry. Doubtless many—nay, even most—of the great discoveries and improvements in the arts and manufactures may have been made by men who have been self-taught. But these men have acquired for themselves, by slow and difficult steps, the same habits of exact observation, patient and laborious devotion, and manipulative or constructive skill which the modern student of science may, at any rate to a very considerable extent, gain in his college course. So valuable is this kind of education found to be, that in Germany, where it is most practised, the chemical manufacturers now refuse to take young men into their works unless they have not merely had a scientific education, but also have prosecuted original investigation.

If, then, education in its widest sense has for its objects, as I presume will be generally allowed, the training of the mind and faculties in such a way as most fully to qualify the possessor to discharge with benefit to mankind his duties in after-life, surely plans for the encouragement of original scientific research should form no inconsiderable portion of the work of every institution professing to deal with the higher education of the country. And yet when we come to look at the provision made for encouraging original research, either at our older or at most of the more modern seats of learning, we are astonished to find that this essential provision is almost altogether ignored. At Oxford and Cambridge thousands of pounds are each year lavished upon the encouragement of classical and mathematical attainments, whilst the claims of original research can scarcely be said to be recognised. Hence these highly endowed universities, whilst they are justly celebrated for their critical faculties, have ceased to represent, in any one direction, the productive power of the country.

Original research, the true life-breath of civilisation, does not in England, as is the case in Germany, look to the universities as the nurseries where its young shoots shall be tended and cherished, for there, at present, its value is scarcely recognised. Indeed, Sir William Thompson has expressed his opinion that the system of examinations at the universities has a tendency to repress original inquiry, and exerts a very injurious effect in obstructing the progress of science. The time is, however, not far distant when this want of appreciation of the value of original research will be a thing of the past, and when the universities will vie with each other in encouraging this mainspring of progress, and in honouring more those whose lives are devoted to this high calling. Owing to the want of means of promoting original investigation in our great seats of learning, the scientific activity of the country has found vent through other channels. No want of encouragement can repress really great minds or powerful wills. Manchester can boast the names of many men who, in spite of want of university aid, have done much for science. Who, for instance, in the whole scientific annals of Oxford, can be placed on a footing of equality with Dalton or Joule? These men are, however, great in spite of our systematic negligence of the subjects, the mastery over which has made their names immortal.

If, in the face of so much that is discouraging in this want of recognition of science, England has still no reason to fear the comparison of her great men of science with those of other countries, we may feel sure that our position among the nations will be raised when the Government, our universities, and the country at large become alive to their duties as regards the encouragement of original scientific research, and when the number of able men who devote themselves to this pursuit shall thereby be largely increased. Much assistance in this direction may confidently be expected from the Royal Commission on Scientific Instruction and the Advancement of Science, of which his Grace our President is chairman, and which has lately published its third report on the progress of scientific education and research in the two old universities. In this report, the importance, from a national point of view, as well as an educational instrument of original research is fully recognised, whilst the means of enabling the universities to take their due share in the management of this branch of human activity is suggested. The evidence given before this Commission by Sir Benjamin Brodie, Prof. Frankland, Dr. Carpenter, and other competent authorities, is of the most decided and unanimous character, and the opinion thus strongly expressed must ere long produce its effect.

The importance of fostering scientific research in connection with higher education is, however, now well understood to the authorities of this college. Very considerable facilities for carrying out original work are given both to the teachers and to the pupils, whilst in the appointment of the professors special weight is always laid on their power of conducting scientific research. In my department, which has now been organised for many years, I make bold to say that we have not been behind any chemical laboratory in this kingdom in the original work we have produced. The physical laboratory, which has only recently been inaugurated, has already, under the care of its talented Director, whose original researches are valued wherever Science is appreciated, done valuable work, and the new department of practical physiology which has just been established will doubtless soon bear fruit of a similar character. In the biological sciences our teaching resources have hitherto been limited; but although this has necessarily prevented the prosecution of research by the students, the professors of this department have long been distinguished for original investigation in their special branches.

To assist in developing in the practical community the appreciation of scientific research, and owing to the liberality of Manchester men and to the wise advice of Prof. Frankland, who then occupied the chair which I have now the honour to hold, a scholarship for original chemical research—our Dalton Chemical Scholarship—was founded in 1853 as a testimonial, and a fitter one could not have been proposed, to our great townsman. The establishment in England of a scholarship for excellence in original research was, twenty years ago, a circumstance without a parallel, but in spite of the novelty of the experiment, time has fully proved the wisdom of the course which its originators adopted. We can already point to a fairly long list of men who have taken our Dalton Scholarship, who now hold high and

* Concluded from p. 539.

responsible positions in scientific, manufacturing, and official life; and these men will all acknowledge the benefit conferred upon them by the training they received when competing for the scholarship, and whilst occupied for the first time in their lives in carrying out an investigation on some original subject.

On the model of our Dalton Chemical Scholarship, an important physiological scholarship has lately been founded in this College by Mr. Robert Platt; the conditions of tenure involve the prosecution of an original investigation in physiology; and it is to be hoped and expected that this scholarship will do as much to stimulate the study of physiology amongst us as the Dalton has certainly done in the case of chemistry. The establishment of similar scholarships in the branches of physics and biology is much to be desired, and benefactions made for these special purposes will assuredly prove of the greatest value.

It is unnecessary for me to point out the direct applications which the knowledge and experience gained in the laboratory receive in the arts and manufactures dependent upon chemical science. These everyone can see for himself. The ordinary routine work of the alkali maker, the dyer, the brewer, the calico printer, calls immediately for chemical knowledge, and manufacturers who do not yet see the value of the training afforded by original experimental investigation, are ready enough to appreciate chemical knowledge if it can show them that their drugs are adulterated or their water impure.

Concerning the exact mode by which encouragement should be given in this country to original research, opinions may differ. One proposal has lately been made by the distinguished president of the British Association (Prof. A. W. Williamson), in his able address at Bradford, which it behoves all interested in the progress of the country carefully to consider. Without attempting to discuss the details of this or other schemes, it may be well to point out those general features of the subject upon which these proposals are based.

In the first place, then, we shall agree that the measures which have to be taken must be systematic, must apply to the country at large, and must include all classes. What we need is the development of the latent intellectual resources of the country as regards science, the means of sifting out from the great mass of the people those golden grains of genius which now too often are lost amongst the sands of mediocrity. This can only be fully accomplished by a system extending from the lowest primary schools up to the highest educational establishments in the land, and therefore almost necessitates the action of Government. But whilst believing that a national system is needed in order that the potential scientific energy of the country shall become active, I for one should most strongly object to the establishment of a complete system of State education. One of our greatest safeguards and sources of national strength has been and is the freedom from Government control which our educational, municipal, and local institutions have always enjoyed; and the evils of a uniform State system as existing in France (which is such that the Minister for Education remarked with pride, that at a given moment the classes in all the Lycees in France were engaged in reading the same chapter in Cæsar's Commentaries) need only be felt to be deplored.

Secondly, it is clear that in order to be able to select from amongst the people those whose mental and physical powers fit them for ultimately advancing science themselves, the rudiments of a scientific training must be much more widely diffused than is at present the case. This can only be slowly accomplished; the methods of teaching science are only beginning to be understood, and, unfortunately, in school teaching the introduction of a scientific subject has too often been looked upon more as an amusement than as a study requiring as much or more attention and exactitude than the older subjects, one which when properly taught acts to quite as great an extent as a mental discipline. Science teachers have yet to be trained, and a system of introducing elementary science as disciplinary teaching into primary and secondary schools has yet to be made general. At the same time new institutions have to be founded in which the higher branches of the various sciences are taught and original research encouraged, and into which youths of conspicuous merit must be drafted, whilst existing colleges and universities have to be modified to suit the requirements of the time. These institutions must contain laboratories, not only for teaching purposes, but suited for scientific research, and the professors must take in a certain number of advanced students to work on original investigation. This is indeed, as Sir Benjamin Brodie points out in his evidence before the commission, an educational function of the most important character; because here scientific education is carried out to its end, and if this is not done, you stop short of the most important part of all in scientific education, for the perfection of science as a means of education is seen only in scientific inquiry. The pupils thus trained eventually pursue science as their main business in life, and become in their time teachers and professors of their subject. Thus by degrees the profession of the investigating teacher will become recognised as one in which the ablest of our youths may obtain reward and recognition, as well as satisfaction and delight, and thus the scientific power of the country will be vastly increased.

Concerning the ennobling nature of original scientific inquiry it is needless for me to say much, for although I should be the last to contend that men of science are free from the foibles and weakness common to all mankind, I think it stands to reason that the habits of mind which an investigator must cherish, are such as must raise him above the petty struggles of ordinary existence, and must, for a time at least, lift him into an atmosphere free from the cloud and smoke which too often darken the usual current of men's lives. In order to give you an idea in what original research consists, and to point out to you the interests attaching to an inquiry, the practical applications of which seem as far distant as those of a newly-discovered planetoid, I will for a few moments draw your attention to a case of the kind with which I happen to be familiar. Amongst the sixty-three different elements of which the earth, so far as we know, is made up, there are many which have been found only in the most minute quantity. Indeed, in the list of elements suspended on the wall, you will notice that a large number out of the sixty-three are marked as rare. A few only of these substances are employed in the arts and manufactures, or are known to play any part in the economy of nature; the rest are rarities of interest at present only to the scientific chemist. It would, however, be presumptuous on our part were we to assume that the existence of these bodies is a matter of no moment, for we are constantly learning that substances hitherto supposed to be useless are of the most vital importance. Hence it is obviously our duty to get to know all we can about the properties of each, even the rarest, of these elementary bodies, and especially about their relation to, and mode of action on, the other elements. It is clear, too, that as long as our knowledge of the properties of any one of these elementary bodies is inaccurate, or if mistaken views regarding any one have arisen, our science must suffer in completeness. For just as an error made in the basement of a house throws the upper storeys wrong, so a mistake concerning the size and shape of the foundation blocks of our science may render the whole chemical superstructure faulty.

In 1830 the great Berzelius fully examined a new elementary body termed vanadium, the existence of which had been previously discovered by his countryman Sefström. Having most carefully ascertained the remarkable properties of this new substance and its compounds with the other elements, Berzelius gave to vanadium and its compounds a certain chemical position and place amongst the other elements. Thus to the compound of vanadium and oxygen containing the largest proportion of the latter element, and called vanadic acid, he assigned the formula V_2O_3, meaning thereby, in the atomic language of our great townsman Dalton, that two indivisible particles or atoms of the metal are combined with three indivisible particles or atoms of oxygen; and these views, enforced by experiments of the most unimpeachable character, were for years universally adopted by chemists.

In 1858 a fact was observed by the German chemist, Rammelsberg, with regard to the crystalline form of the best known mineral containing vanadium which exhibited Berzelius's conclusions in a new light. It had long been known that substances which have an analogous chemical composition are found to crystallise in an identical form. Thus the different alums containing alumina, oxide of iron, oxide of chromium, oxide of manganese, all crystallise in octahedra; and the oxides contained in these alums have all an analogous composition; that is, the relations between the number of atoms of metal and of oxygen in each case is identical. Now, Rammelsberg found that the crystalline form of a mineral contained vanadic acid, and lead was identical with another mineral containing phosphoric acid and lead. Hence we should expect to find that the oxide of vanadium, termed vanadic acid, and the oxide of phosphorus, called phosphoric acid, possess an analogous chemical constitution. Such, however, was found not to be the case. Phosphoric acid is well known, and, without doubt, consists of two atoms of phosphorus, united with five atoms of oxygen, whereas Berzelius only found three atoms of oxygen to two of the rare metal in vanadic acid. How is this discrepancy to be explained? We have here to do either with an exception to the otherwise general law of isomorphism, so that we may have identity of crystalline form, *without any analogy in chemical composition, or Berzelius's experiments* and conclusions respecting the constitution of this vanadic acid are incorrect. By experiments on the properties of vanadium and its compounds, made with much larger quantities than it fell to the lot of the Swedish chemist to work with, it was shown that something had been overlooked by him. It was proved that the substance which he supposed to be a metal was not a metal at all, but an oxide, and that vanadic acid really contains more oxygen than he believed it to contain. And what is remarkable is that this quantity of oxygen, which had been overlooked, is exactly the quantity which is needed in order to make the constitution of vanadic acid identical with that of phosphoric acid. We have to take out of each atom of Berzelius's metal one atom of oxygen in order to get the true vanadium, so that the real atomic weight of this element is less than that given to it by Berzelius by the atomic weight of oxygen, $67·3 - 16 = 51·3$. Thus the chemical constitutions of phosphoric and of vanadic acids are represented by the formulæ P_2O_5. V_2O_5. The law of isomorphism remains unassailed, and the goddess (Vanadis is a cognomen of the Scandinavian goddess Freia) who was found wandering as a waif and a stray amongst her companion elements, has been restored to her natural friends, and now forms a recognised member of a family group.

To sum up, my aim in the foregoing remarks has been to show that if freedom of inquiry, independence of thought, disinterested and steadfast labour, habits of exact and truthful observation, and of clear perception, are things to be desired as tending to the higher intellectual development of mankind, then original research ought to be encouraged as one of the most valuable means of education. And that on this ground alone, and independent of the enormous material benefits which such studies confer on the nation, it is the bounden duty not only of the Government, but of every educational establishment, and of every citizen of this country who has the progress of humanity at heart, to promote and stimulate the growth of original research amongst us.

HELVETIC SOCIETY OF NATURAL SCIENCES

THE fifty-sixth annual meeting of this society was held on the 18th, 19th, and 20th of August last, at Schaffhouse, under the presidency of Dr. Stierlin, and is described as having been a highly animated one. We shall note a few of the more important papers presented; for particulars of which we are indebted to the *Archives des Sciences*.

In the section of Physics and Chemistry, M. Soret described a method for studying ultra-violet spectra. It consists in placing a thin fluorescent lamina (sulphate of quinine, *e.g.* between two glass plates) before the eyepiece of a spectroscope, where the image is formed, and observing, with sufficient inclination of the eyepiece the image of the ultra-violet spectrum then developed on the lamina. Prof. Kopp read a paper on bresiline and its derivatives. The Deacon process of manufacturing chlorine was the subject of a paper by M. Hurter, which gave rise to lively discussion. Dr. Heim, who has been observing the sounds of cascades, find they all give the note C sharp, or F.

In Geology, Dr. Schalch had a paper on the volcanic rocks of Höhgau. These are in two groups, that of basalts, and that of phonolites. They form isolated cones surrounded with thick deposits of volcanic tufa, the nature and arrangement of which indicate that the eruptions happened at successive intervals about the end of the tertiary epoch. M. Favre showed a section of the Vaudois Alps made at Pleiades, near Vevey aux Ormonts; in which he distinguishes three zones, consisting of superior Jurassic and Necomian, and different portions of Eocene, strata. Dr. Heim exhibited a new method of geological representation of a country; it consists in a series of sections, on the same scale, coloured and fixed vertically at equal distances on a geological map. He also made some observations on the zone of contact of crystalline rocks and sedimentary strata in Eastern Switzerland and the Bernese Alps. M. Lang announced the early publication, by the Alpine Club of a glacier-register, in which information will be given as to dimensions, form progress, &c., of glaciers. At the first general *séance* Prof. Heim gave a valuable *resumé* of the various theories of glacial motion. At the second, Prof. Desor presented a memoir on *morainic* landscapes, by which he denotes those indicating a former extension of glaciers. The most striking types are at the southern base of the Alps. There is discernible a zone consisting of a succession of verdant hillocks, sometimes aligned, sometimes separate; these are found to be composed of the *débris* of old formations bruised and triturated, and clearly indicating glacial action. A good example occurs at the base of Monte Campo di Fiori.

At the general opening *séance* Prof. Forel gave an account of his researches on the deep-water fauna in Lake Leman, of which he enumerates some thirty species. He had also studied the fauna of the lakes of Neuchatel, Zurich, and Constance. His conclusions are briefly these:—There are in the lakes three distinct fauna: (*a*) a littoral, extending to 15 or 20 metres depth; (*b*) a deep fauna, from 20 to 300 metres; and (*c*) a pelagic fauna. All the forms of the deep fauna have analogous or similar forms in the littoral fauna; but the converse does not hold, At the same level the deep fauna are the same. A few species found between 30 and 100 metres are not found at 300 metres. but all the types at 300 metres are found between 30 and 100 metres. There are local and seasonal differences. The deep fauna are best studied between 30 and 60 metres. In comparing different lakes the general characters of deep fauna are the same, but special characters vary.

In the section of zoology and botany, M. Bugnion described some sensitive organs found in the epidermis of Proteus and Axolotl. They are considerably developed in the former (1460 were counted in one specimen), and are disposed in linear groups of three or four along certain nerves of the head, and the lateral nerve to the end of the tail. They resemble the cyathiform organs discovered by M. Leydig in 1850, in the epidermis of fishes. Dr. Cartier gave a paper on the sensitive hairs of crocodiles.

In the medical department Prof. Karsten, of Vienna, made a communication on *necrobiosis* in which he pointed out that Bacteria, Vibriones, and micro-coccus, &c., are not to be regarded as organic species, properly so called; the phenomena of animal reproduction have never been observed in them. They are pathological products, which grow in the interior of vegetable or animal cells, but which do not penetrate these when once developed, as parasites.

In the department of Pure Mathematics the principal paper was by Prof. Schwarz on a new example of a continual function which does not admit of derivatives. This paper will be found *in extenso* in the *Archives*.

This is the third time in its history that the Helvetic Society has met at Schaffhouse, the former occasions having been in 1825 and 1847. The next annual session is to be held at Coire.

SCIENTIFIC SERIALS

Sitzungsberichte der Königl. Böhmischen Gesellschaft der Wissenschaften in Prag. Jan. 1871 to June 1872. (3 numbers).—Among the more valuable matter in these numbers may be noted some contributions to palæontological botany; more especially a paper by M. Feistmantel describing the various fruit-forms met with in Bohemian coal formations. (As published separately, the paper contains several excellent plates). The same author communicates also full accounts of the flora in coal-measures at the foot of the Riesengebirge, and at Merklin.—M. Dvorak describes some curious experiments on individual differences between the two eyes, and between different parts of the retina of the same eye. He shows that two non-simultaneous impressions, each affecting one eye, appear simultaneous, when the time-interval is of a certain length; this interval he measures with suitable apparatus.—In chemistry we have a note by Prof. Stolba, giving a new method of preparing borofluoride of potassium, and an account of the properties of this substance.—Dr. Weyr investigates mathematically the distance-action of electrical solenoids on material plane surfaces; and a note by M. Domalip furnishes experimental proof of certain laws deduced by M. Dub as to the dependence of magnetic moment on the dimensions of a magnetic bar.—There are also papers on the fauna of lakes in the Böhmerwald, on basaltic formations, and on several points in mineralogy and pure mathematics.

Bulletin de l'Académie Royale de Belgique, No. 8, 1873.—In this number is described a recording *meteorograph*, devised by M. Van Rysselberghe, and which seems to have some merit;

the advantage being that the readings of several different instruments can be recorded by means of a single steel graver, making traces on a varnished copper sheet. The sheet is fixed on a vertical cylinder, which rotates at equal intervals (*e.g.* every ten minutes); an electric circuit, of which the instrument to be observed forms part, is closed by the movement of the cylinder; this liberates the graver, which then gives a tracing proportional, in length, to the indication of the instrument. At each revolution the graver descends a little; thus a series of equidistant lines are obtained, the extremities of which form the curve of observations. The copper sheet is afterwards dipped in an acid and thus made ready for engraving.—M. Terby communicates some drawings made by M. Schroeter, in the end of last century, which show the configuration of the spots of Mars at that time. He finds, in these, fresh proof of the permanence of the spots.—A letter from Prof. Genocchi, of Turin, on several mathematical questions, calls forth a long report from M. de Tilly with reference to the alleged impossibility of demonstrating the postulates of Euclid by plane geometry, or by any geometrical reasoning.—We further find notes on the congelation of alcoholic liquids, (Melsens), on the motion of projectiles, on hypo-sulphurous acid, on some storms at Aartselaer in July, and other topics.

Bulletin de la Société Impériale des Naturalistes de Moscou, No. 1, 1873.—In this number there is a valuable paper of spectroscopic solar observations in 1872, by M. Bredichin. Four plates are appended, showing the spectroscopic profile of the sun from July 22 to September 10. The author's results confirm, in the main, those of Secchi.—M. Berg gives some particulars as to the successful acclimatisation of a Japan silkworm, the *Antherea Yama Mayu*, in the Baltic provinces. Cultivators were looking in this direction partly because of the difficulty of acclimatising mulberry in the north; the new animal feeds on oak leaves. One striking fact is, that some of the eggs were exposed, at times, for three days successively, to a temperature of 12° R., without apparent injury. The temperature at which the worms were kept after leaving the egg till spinning time, varied between 12° and 16° R. The entire extra-oval life of the Yama Mayu in Riga is about 16½ weeks; or 9 in the caterpillar, 6 in the chrysalis, and 1½ in the moth stages respectively. Experiments, extending over three years, have fully shown that the scheme in question is a practicable one. We have further to note a long and interesting account, by M. Wolkenstein, of certain ancient cemeteries named "Jalnikis," found on many of the hill-sides in Novgorod. The tombs are made of unhewn stones arranged in form of a rectangular cyst, which contains the skeleton. In his study of the question whether these cemeteries belonged to ancient Novgorodians, or some other people, the author is led to assign a Slavic origin.—Among the remaining papers are a note by M. Stepanoff on the development of Calyptræa, and a reply by M. Lubimoff to M. Bredichin.

Reale Istituto Lombardo di Scienze Lettere Rendiconti Fascicolo, XV, 1873.—In addition to a large quantity of historical and philosophical matter, which includes a fourth paper on Kant's philosophy, by C. Cantoni, this number contains observations of Comet II, 1873, by S. Tempel; a long paper on the polymorphism of *Pleospora Herbarum*, by Drs. Gibelli and Griffini; and also some anatomical and medical notices.

THE *Annali di Chimica applicata alla medicina* for September contains the usual number of notices on pharmaceutical preparations, &c.

American Journal of Science and Arts, October.—This number contains a description of some valuable improvements in the silt analysis of soils and clays, by Mr. Hillgard. From minute observations on the working of the elutriating apparatuses of Nöbel, Schulze, Fresenius, and others, he concludes that all determinations hitherto made with conical vessels are vitiated by irregular currents, and a kind of miniature avalanche formed by the particles. He employs a cylindrical elutriating tube, having a rotary churn attached to its base, but screened by wire from the liquid column. This has given good results.—Prof. Dana has a (continued) paper on the quartzite, limestone, and associated rock of the vicinity of Great Barrington, Berkshire Co., Mass.—Mr. May describes some experiments on the determination of lead as peroxide, and Mr. Remsen communicates a note on isomeric sulpho-salicylic acids.—Mr. Bentham's anniversary address to the Linnean Society is given; also a French Academy notice of Dr. Verneuil, who did valuable service to North American geology.—We further note accounts of various survey operations in Colorado, Sierra Nevada, Utah, &c.

Atti della Reale Academia dei Lincei Roma, Dec. 1872. This publication contains, among other papers, an interesting description, accompanied with plates, of certain human bodies found in a remarkable state of preservation in a cemetery at Ferentillo. The authors, MM. Maggiorani and Moriggia, made analyses of the soil, which abounded in salts of lime having, of course, avidity for water. The ground was porous, and readily permitted passage of vapour from one stratum to another. Scarcity of humus and good ventilation were other favouring causes. There was a popular tradition that the soil was brought from Palestine, but this is thought incorrect. The mummies were throughout invaded with sporulæ and various other parasites, which doubtless contributed to the mummification.—A long paper by M. Volpicelli offers a complete and general solution, through the geometry of situation, of the problem relating to the course of a horse over a checkered surface.—Prof. Cantoni has an article on the various modes of electrical testing (*esplorazione*) and on the influence of hypothesis in electrostatics; in which he makes some strictures on certain passages in Tyndall's little work on Electricity, referring to the existence of two fluids.—We further notice a paper by Prof. Cadet on the functions of the white nerve substance, and one by Prof. Respighi on the shower of falling stars observed November 28, 1872.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Oct. 20.—M. de Quatrefages, president, in the chair.—The following papers were read:—Theory of the movement of a point attracted towards a fixed centre, by M. J. Bertrand.—On Dr. Reye's explanation of the solar spots, by M. Faye. Dr. Reye considers that the heat of a facula causes an up-rush and expansion of the superincumbent atmosphere, causing a sort of vortex through which the materials of lower strata rise, expand, cool down, and condense. M. Faye, after explaining the theory in question, argued that a very simple fact overthrows it at once. Dr. Reye's theory would make the vortex or spot *on* the sun, while the measurements of Carrington have shown that it is really *in* the sun.—Anatomical researches on the tardigrade *Edentata*, by M. P. Gervais.—M. Alph. de Candolle presented the last volume of the "Prodromus Systematis Naturalis Regni Vegetabilis."—The secretary reported on a number of papers on the *Phylloxera*.—Researches on an easy method of measuring the capacity of ships, by M. d'Avout.—Additional note to the monograph on the fish of the family of the *Symbranchidæ*, by M. C. Dareste.—On the production of galls on vines attacked by the *Phylloxera*, by M. Max Cornu.—On the reproduction of the oak *Phylloxera*, by M. Balbiani.—On the production of certain crystalline borates in the dry way, by M. A. Ditte. The paper in question described several borates of barium and magnesium, and also several double salts of the same class.—Note on the chlorovanadates, by M. P. Hautefeuille.—On the production of methylamines in the manufacture of pyroligneous products.

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