THURSDAY, OCTOBER 31, 1878

SCIENTIFIC WORTHIES

XIII.—SIR GEORGE BIDDELL AIRY

SIR GEORGE BIDDELL AIRY was born at Alnwick, Northumberland, on July 27, 1801. He was first educated at private schools in Hereford and Colchester, and passed at the age of eighteen to Cambridge, where he entered at Trinity College as sizar. Here he developed his love for mathematics and graduated as senior wrangler in the year 1823.

In the following year, being elected a Fellow of Trinity College, he was closely engaged with the introduction of a new class of studies into the University, and published his "Mathematical Tracts on the Lunar and Planetary Theories," the "Figure of the Earth," &c., and the "Undulatory Theory of Optics," a work of considerable merit, which showed at once both the ingenious mathematician and the accomplished philosopher. In the year 1825 he wrote for the Cambridge *Transactions* papers "On the Forms of the Teeth of Wheels," and "On Escapements."

In the following year he was elected Lucasian Professor of Mathematics, and applied himself with the utmost ardour to the promotion of the knowledge of experimental philosophy in the University, and a great many of his papers, published at that time and afterwards in the *Transactions* of the Cambridge Philosophical Society, bear on those subjects, and principally on the most remarkable of them, Undulatory Optics, a field of research quite new at that time. The requirements of universities were never afterwards lost sight of. He gave, for instance, in the year 1868, a course of lectures in the University of Cambridge on the subject of Magnetism, with the view of introducing that important department of physical science into the studies of the University. His books—"Theory of Errors of Observations," "On Magnetism," and various memoirs in the *Transactions* of learned societies were written principally for this purpose.

In the year 1828 he was elected Plumian Professor of Astronomy, and was charged with the directorship of the Astronomical Observatory, where he had to superintend the erection of several instruments, principally the mounting of the great Northumberland equatorial, which was constructed almost entirely under his own direction. In the same year he was elected a Fellow of the Royal Astronomical Society; and now commences an activity which is almost unsurpassed in the annals of astronomy.

Prof. Airy, after the example first given by Maskelyne, and followed by Bessel and Struve, introduced into the observatory a most efficient system for reducing the observations, and printed them annually. The greatest regularity in the routine of consecutive years was aimed at and attained, in great measure, from adherence to the rule of forming the plan of observations for each year in the greatest detail practicable before the close of the preceding year.

These practical occupations did not divert his mind from theoretical studies. In the year 1831 a most important paper was published in the Cambridge *Transactions*, "On the Inequality of Long Period in the Motions of the Earth and Venus." In the following year he wrote for the British Association a very interesting "Report on the Recent Progress of Astronomy," a little work which may be read still with great profit by every student of astronomy. Various lacunæ of our science discovered on that occasion were filled up by Prof. Airy in the next year by his papers "On the Mass of Jupiter."

When Mr. Pond, the fifth Astronomer-Royal, resigned in the year 1835, Prof. Airy was appointed his successor, by Lord Auckland, first Lord of the Admiralty, and at the same time he was elected President of the Royal Astronomical Society. During the forty-three years that have elapsed since his appointment as Astronomer-Royal, Sir George has always been most keenly intent in promoting astronomy and science in general in every way.

He has equipped the Royal Observatory at Greenwich with a series of new instruments of very exact construction, all made after his own designs, many of them invented by himself. The first of the new instruments was erected in the year 1847. It was constructed in as few separate parts as possible, and no important parts were connected by small screws, in order that the instrument might possess the greatest amount of firmness. The end to be attained by its use was to make observations out of the meridian as accurate as observations in the meridian, and its main object of observation was the moon. It must be recollected that the moon can very seldom be observed with the meridian instruments before her first quarter and after the last. The altazimuth was designed to obtain observations of her as often as she was visible in the sky and, I am sure, every astronomer will agree that the erection of this instrument was a most important innovation. Its great services were fully acknowledged many years later, when the greatest errors in Burkhardt's Tables of the Moon were shown to exist in parts of her orbit never accessible to meridian observations. The number of days on which the moon is observed by this instrument is nearly double that of the observations in the meridian.

At the end of the year 1850 the new meridian circle was erected, the object-glass of which, made by Mr. Simms, has 8 inches clear aperture and 11 feet 6 inches focal length. With this instrument there was also introduced a great change in the observing routine at Greenwich, the transits and the zenith distances of the stars being now taken by one astronomer at the same time. Nearly simultaneously the American method of observing transits was adopted.

The Troughton zenith-sector, found by Mr. Airy at the Observatory, had given much trouble, and various alterations had not improved the results obtained by it. It was therefore dismantled in the year 1848, and the "reflex-zenith-tube" erected, an instrument admirably calculated for observing the small changes in the zenith distances of γ Draconis, the Greenwich zenith-star.

When all these new instruments were well in working order, Mr. Airy directed the attention of the Board of Visitors, in the year 1855, to the fact that the extra-meridional apparatus was by no means fit for the present wants of astronomy. A large object-glass (12 French inches in diameter) was, in consequence, procured by the Astronomer-Royal from Mr. Merz, and was mounted in the manner which was formerly adopted by Mr. Airy in the mounting of the equatorials at Cambridge and Liverpool. With the inauguration of the new equatorial in the year 1859 the change from the old state of the Observatory was complete. There was not then a single person or instrument in the Observatory that had been there in Mr. Pond's time.

A fifth new instrument was planned by Mr. Airy in the year 1869, and erected in the following year in the Royal Observatory, in order to decide the most delicate question of the dependence of the measurable amount of sidereal aberration upon the thickness of the glass or other transparent material in the telescope. The tube of a telescope (the lenses of which were ground to proper curves) was filled with water, and the telescope mounted as zenith-sector. Several years' observations of γ Draconis did not reveal a perceptible difference in the constant of aberration found in this manner from the value generally adopted.

Of the instruments invented by Sir George Airy I may mention also the double-image micrometer, a very useful apparatus, if thoroughly investigated; the eye-piece for correcting the atmospheric dispersion; the orbit-sweeper, a most ingenious contrivance to detect comets approaching perihelion passage, the time of which cannot be exactly fixed.

The observations were made, under his own responsibility, during nearly half a century, without interruption, reduced with great care, regularly printed, and—a very essential thing—very liberally distributed. They form a vast collection of the most important fundamenta of astronomy. Every year Sir George publishes a report on the work done in the Royal Observatory; these reports form a series which will be of the greatest use for the writer of the history of astronomy and science in general in the nineteenth century.

Since the year 1833 the incessant activity of Sir George Airy had been directed to an undertaking, proposed to astronomers by Bessel, in the preface of his "Tabulæ Regiomontanæ," viz., the reduction of the Greenwich lunar and planetary observations since 1750. This most arduous task was completed in the year 1848; and we may say that our present tables of the motions of the moon and the planets rest, for the greatest part, on those bulky volumes, containing these reductions.

But not only was this immense magazine of dormant facts opened by Sir George to science: he reduced also the observations of Groombridge, of Catton, and of Fallows, the first Astronomer-Royal of the Cape of Good Hope. The importance of these reductions is not limited by the usefulness of the observations themselves to the astronomer by the appearance of the "Star-Catalogue," containing Mr. Groombridge's most valuable observations. Mr. Johnson, for instance, was induced to undertake those beautiful observations of circumpolar stars, forming afterwards the Radcliffe catalogue of stars. Prof. Hansen, of Gotha, was very materially supported by the Astronomer-Royal in finishing his great work on the moon and calculating tables of her motion.

The pressure of daily work and the responsibility of keeping up the Greenwich series of solar and lunar observations absolutely uninterrupted, did not prevent the Astronomer-Royal from taking up other scientific questions of the day. In the year 1842 he made a voyage to Turin, in order to observe the total solar eclipse; the same object induced him to visit Gothenburg, in Sweden, in 1851, and to organise, in the year 1860, the famous *Himalaya* expedition to Spain.

His great interest in every branch of his favourite science is evinced by the recent introduction at Greenwich of heliographic and spectroscopic services.

In the year 1847 Sir George went to Russia for the purpose of inspecting the new Russian Central observatory. It is highly gratifying to read with what absence of prejudice the great astronomer expresses himself in regard to this observatory, the personal establishment of which and the construction of instruments is so very different from those at Greenwich.

Magnetical and meteorological observations were not made at Greenwich before the time of the present Astronomer-Royal. Sir George Airy proposed to the Government to make them at Greenwich, and since 1838 the new Magnetical and Meteorological Observatory has been in activity. He introduced for this department also the self-registering instruments constructed by Mr. Brooke.

In later years the Astronomer-Royal has been oppressed with the difficulty of making the meteorological observations practically available. With a store of records, extensive, accurate, and rich, beyond any other which exists, he does not see a probability of physical connections or physical laws sufficiently strong to induce him to enter confidently on an expensive comparison, and he expresses strongly his opinion, that the want of meteorology at the present time is principally in suggestive theory.

Only very briefly can I mention his very useful experiments on iron-built ships, for the purpose of discovering a correction for the deviation of the compass, which resulted in a system of mechanical corrections, universally adopted; his researches on the density of the earth by observations in the Harton Colliery; his extensive aid to Government in recovering the lost standard for measures; in fixing the breadth of railways; in introducing a new system for the sale of gas, &c. All these transactions have proved Sir George Airy "the thorough man of business." Indeed, the promptness of his correspondence and his kindness in answering every scientific inquiry in the most minute manner, is most remarkable and seldom to be met with in so profound a philosopher.

In recent years the Government intrusted to his care the equipment and instruction of the British Expedition for the Transit of Venus, a subject which had engaged the attention of the Astronomer-Royal during thirty years, and had induced him to write a number of most important papers on the matter. In the year 1848 he gave a series of lectures on this difficult subject at Ipswich. The whole responsibility for reducing the observations made during the transit rests likewise with him. Much of his time has, during the last few years, also been spent in promoting the lunar theory by a method of his own.

Sir George Airy has, of course, deservedly received the recognition of his country and the scientific world in general. He is medallist of the French Institute, of the Royal Society (twice), of the Royal Astronomical Society (twice), and of the Institute of Civil Engineers. Most scientific societies are proud to have his name on their list of members; he is one of the eight Associés Étrangers de l'Académie des Sciences à Paris.

A. WINNECKE

FOREIGN ORDERS

IN several articles and letters in vol. viii. of NATURE the question of the conferment of foreign orders on British subjects, so far as it concerns men of science, was pretty thoroughly discussed, as well as the proposal made in Parliament, in 1873, to establish an order of intellectual merit. The subject has again come up in connection with the distribution of awards at the close of the Paris Exhibition, and there has been much disappointment and even bitterness of feeling expressed at the refusal of our Government to allow British subjects to accept the coveted Cross of the Legion of Honour. It is well known that many of our men of science, as well as others, possess foreign orders in abundance, and that our Government takes no notice unless consulted, when, on the ground of some antiquated regulations, it thinks it its duty to refuse permission to accept such orders. If not illegal, it is at any rate weak and childish on the part of Government to take such a course, worthy of the days of "good" Queen Bess, who wished her dogs to wear no collars but her own. In the case of the Exhibition awards it has been shown that this decision on the part of our Government falls with peculiar hardship on British exhibitors. It will very naturally be inferred by the general public that as a body they occupy an inferior position to foreign exhibitors, who are allowed to accept the great French honour, which is conspicuous by its absence from the awards in the British department. It is especially hard, we think, upon those who have served on the British jury. From some parsimonious caprice on the part of Government no allowance was made to those who served as jurors at the Paris Exhibition, and the eminent men of science who gave up their time and knowledge for the benefit of the country and the world not only go entirely unrewarded, but must have been seriously out of pocket. One case we know of—and we believe it is not the only one—where a well-known chemist, besides incurring serious expense, worked so hard as to materially affect his health, and all not even for bare thanks.

So far as we ourselves are concerned, we are not anxious to see men of science eager to obtain, or easy to be satisfied, with such honours as those which, if they are simple enough to ask, they are told they must not accept. Our own Government is niggardly enough in its recognition of the services done by the scientific worker to his country; and how can it be otherwise with a Cabinet that has scarcely a member, we believe, who knows the difference between a telescope and a telephone. Fortunately for his self-respect, the purely scientific worker, however eminent he may be as such, is rarely, if ever, embarrassed by the offer of honours from our own Government. These are reserved for the militant and civil services, where, as a rule, they are least requisite, seeing that those who obtain them are generally pretty well paid for their zeal. As for what is called the "honour" of knighthood, it has now become so common, so easily obtainable, that the mere offer of it must make one suspect that after all he must be regarded by its dispensers as a very tenth-rate man. We know of a humble grocer in a small country town in the north in which a statue erected to the late Prince Consort was unveiled by the Queen, when the decent man happened to be provost; of course he was dubbed "Sir," and his life was ever after rendered miserable by the waggish little urchins of the town, who would gravely pass their cans across the counter for "A bawbee worth o' treacle, Sir Dawvid." And C.B. is rapidly becoming little better, so that virtually in this country there is no imperial honour attainable by the purely scientific worker, however eminent, which his self-respect would permit him to accept entirely without question.

As to the creation of an order of merit for men of high eminence in science, literature, or art, we have already expressed our opinion. In the present state of things it is better to let the existing chaos alone. Who is there among those who would now have the dispensation of such an honour who is capable of selecting those really most worthy of it? Had we a Minister of Science, with a council of scientific specialists to guide him, then there would be some chance that such an honour would reach those who really deserved it; but at present it is hopeless. Indeed the devotee of scientific research would much prefer that Government, if it desires to do science honour, would do so by giving her substantial aid to pursue her work, than that it should load her servants with all the honours at her Majesty's disposal.

Still with the parsimony both of money and "honours" at home, it is peculiarly hard that scientific men can accept the distinctions which foreign governments are ready enough to award only as if they were contraband goods. Literature and art are abundantly rewarded in both ways, but, like virtue, science, on which the substantial welfare of the world depends, is its own reward; but this, unfortunately, is not marketable. We trust that the present outcry will lead to a modification of the unreasonable regulation as to foreign orders.

THE "ENCYCLOPÆDIA BRITANNICA"

The Encyclopædia Britannica. Ninth Edition. Vols. vii. and viii. (*Deacon* to *Fakir*). (Edinburgh: A. and C. Black, 1877-78.)

IN the article ENCYCLOPÆDIA, which finds a place in the second of the volumes now before us Mr. Lyons defines an encyclopædia as a book treating of all the various kinds of knowledge. The definition applies well enough to the older encyclopædias, composed when it was still thought practicable to set forth in a single work all that was worth knowing in science and art. To define the province of a modern encyclopædia is a more difficult task, which will probably be avoided by every one who is not compelled either to plan and edit a work of the kind, or to review an editor's plan. Smaller cyclopædias, on the type of the "Conversations Lexicon," naturally limit themselves to such an abstract of miscellaneous information as may be of service to the ordinary reader. No article is admitted which requires for its comprehension either special preparation or special application. The "Encyclopædia Britannica" aims at something more than this; it addresses itself to the general readers, but it also has a real value for students. On this large plan it becomes very difficult to adjust the respective claims of the two classes to whom the work appeals, and the practical solution must probably be to give what is likely to attract purchasers of a special class without repelling the general public in larger numbers. This seems to be what Prof. Baynes has in view when, along with such articles of general interest as Mr. Freeman and Mr. Gardiner's ENGLAND, he gives us on the one hand an abstruse essay on ELASTICITY, bristling with mathematical formulæ, and on the other a selection of hints for success in playing EUCHRE.

The chief difficulty in successfully carrying out so large a plan lies in the scientific monographs, and more especially in the treatises on subjects which cannot be thoroughly handled without mathematics. In the ninth edition these articles are of a very high class. The editor must be congratulated who, within the two volumes now before us, has articles by Prof. Clerk Maxwell on DIAGRAMS, DIFFUSION, and ETHER, by Sir W. Thomson, on ELASTICITY, by Prof. Cayley on EQUATION, and by Prof. Chrystal on ELECTRICITY. All these are admirable pieces of scientific writing of different kinds. The article Electricity is a singularly clear and well-arranged exposition, which, if printed as a separate volume, would form the best possible text-book for students who are well advanced in pure mathematics. On the other hand Prof. Cayley's account of Determinants and the Theory of Equations is not of the nature of a text-book, but can be appreciated only by those who have some knowledge of the subject. Prof. Maxwell's papers, full of his usual quaint illustration and felicitous turns of expression, sometimes amounting to scientific epigram, would be perfect encyclopædia articles if the ordinary reader possessed accurate habits of thought on physical subjects without actual physical knowledge. But in the present condition of things they are most likely to serve an opposite purpose in clarifying the thoughts of those who have already some reading on the topics dealt with. All these papers suggest the question whether an Encyclopædia of general information ought not to limit itself to articles which can be followed by a painstaking reader who has no other preparation or assistance than he can find in the Encyclopædia itself. Yet, on the other hand, we are grateful to the editor who has opened his pages to so much valuable writing which otherwise might never have appeared at all.

In passing from this topic we may notice, in the article ENERGY, a curious over-statement of the inference to be drawn from the ingenious speculation associated with what are called Prof. Maxwell's "demons." We are told by Mr. Garnett that this speculation "shows that the principle of dissipation of energy has control over the actions of those agents only whose faculties are too gross to enable them to grapple with those portions of matter in virtue of the relative motions or relative positions of which the energy exists with which they are concerned." Mr. Garnett has forgotten the trap-doors which the hypothetical demons command. In fact the simplest form of the hypothesis would be to drop the demons, and make the trap-doors themselves intelligent beings, possessing resistance, and capable of moving without expenditure of energy. Such beings would not be controlled by the law of dissipation, but they would differ from all agents known to observation in a more essential point than the possession of subtler faculties.

Passing over less abstruse branches of science, which are well represented in these volumes by Prof. Huxley, Mr. Wallace, Prof. McKendrick, and other names of mark, we must devote a few sentences to the articles which deal with the history of human life and the movements of human thought. A valuable feature in the editor's plan is the prominence given to subjects connected with the ideas, habits, and traditions of primitive man. In this line we have an excellent article on DELUGE, by Mr. Cheyne, and a very interesting paper on DEMONOLOGY, by Mr. E. B. Tylor. Some of the facts adduced in the latter article may probably need further sifting. We do not think so highly as Mr. Tylor does of Maury's book on magic. Lenormant's work on Chaldean magic must be used with reserve, and, to mention but one other point, the theory of a schism between Indians and Iranians, connected with a change in the meaning of the word *deva*, is open to grave objections. Among properly philosophic papers Mr. Sully's EVOLUTION is valuable from its comprehensive survey of the history of the subject, while Mr. Sidgwick's sketch of the progress of ethical speculation, which may be said to replace Sir J. Mackintosh's dissertation, written for the seventh edition of the "Encyclopædia," gives striking proof of the real advances that are being made in what is often regarded as the most stationary department of human thought.

The articles in Geography, History, and Biography, which to the general reader form the most valuable part of a book of reference, are as a rule very good. Subjects of special importance or attractiveness are treated in these as in the previous volumes by writers of distinguished position and special information, while the minor articles speak well for the diligence and scholarship of the permanent staff. In a few cases material taken over from the last edition might with advantage have been more strictly revised. In conclusion, we would offer one or two hints for this part of the work. It is very desirable that bibliographical references should be as complete and uniform as possible. At present there is considerable inequality in this respect, both as regards the statement of sources of information, and the enumeration in the biographical articles of authors' works and their editions. In such an article as that on DICTIONARY it would be unfair to expect completeness or absolute freedom from error, and one does not complain of such a slip as the reference to Rabbi Iona ibu Ganach's Lexicon as still unpublished, when in reality it has been edited by Neubauer. But an enumeration of modern books upon Ethiopic ought not to have omitted Dillmann's Grammar and Lexicon, and an article on EPHESIANS is not complete without reference to Holtzmann.

There is one other point which a reviewer ought not to pass over. In every encyclopædia there must be a certain amount of mere compilation by men who have not made an independent study of the subject dealt with. But the public has a right to expect that work of this kind shall not appear with the signature of men of known literary standing. In making this remark we have an eye on Principal Tulloch's article, EUSEBIUS. The whole article is the slimmest literary hack-work, and the notice of Eusebius' works contains mistakes which can be best explained by supposing that the writer was hastily abridging from Smith's "Dictionary," from which several sentences are copied almost word for word. What is said about the "Chronica" is one tissue of error and confusion. The whole work is described in terms that apply only to the second book. The Latin translation of the Armenian version appears to be confounded with the original work, and there is not one syllable to indicate that only fragments of the latter exist. So, again, the "Præparatio Evangelica" is described as a collection of facts and quotations from the works of the ancient philosophers, without any allusion to the important fragments of ancient historians which it embodies. The celebrated Nitrian MS. of the Theophania is said to have been found in an Italian Monastery. And finally, there is no account of the editions of Eusebius, not even of Schöne's great edition of the Chronica.

OUR BOOK SHELF

Cyprus: its History, its Present Resources, and Future Prospects. By R. Hamilton Lang. Illustrations and Maps. (London: Macmillan and Co. 1878.)

THIS, we venture to think, is really the most important and useful contribution to a knowledge of our new dependency that has been published since the surprise was announced. Mr. Lang's long residence in the island and his position there have given him exceptional advantages to acquire a thorough knowledge of it in all its aspects. He has, moreover, made diligent research into the history and antiquities of the classical island, and has succeeded in presenting in this volume a clear and instructive account of these. Mr. Lang maintains that Cyprus must have had a somewhat civilised population before the arrival of either Greek or Phœnician colonists, and that the remains of early writings which have been discovered prove these earlier inhabitants to have been Aryan, and not Semitic, and probably of the same parent stock as the Greeks. About one-half of the work is devoted to the history of the island. In the chapter devoted to agriculture and produce Mr. Lang shows that, in this respect, the capabilities of the island are very large, and that, with improved systems, it might really be made one of the most fruitful of our dependencies. He himself made long experiments in farming, and with the most satisfactory results; and for intending settlers in the island this part of his work will prove of much value. Mr. Lang gives a condensed account of M. Gaudry's researches on the minerals of the island; but our knowledge of its geology is by no means satisfactory, and we trust with Mr. Lang that no time will be lost in getting a thorough geological survey of the island. The chapters on archæology and rock tombs and their contents are of special interest; and of great practical value is the chapter devoted to "my farm in Cyprus." Mr. Lang is very hopeful of the results of this annexation. One of the most interesting results, so far, in our opinion, is his own work on the island. The five beautiful maps by Stanford add much to the scientific value of the work.

Studies in Physical Science. By W. J. Millar, C.E. (London: Marlborough and Co.)

IT is difficult to imagine what want this little book of 102 pages is intended to fill. In form and matter it appears not unlike a schoolboy's notes of some popular lectures. If any one really desires simple and accurate information on the elementary propositions of physical science he can have no difficulty in finding it in the many brief works which have recently appeared from the pens of the foremost authorities on each special branch. What are we to make of the following paragraphs when it is stated in the preface that "the whole has been carefully revised and the most recent scientific views considered"? "The vapours which ascend from the surface of our globe are the channels by which the electricity of the atmosphere is supplied. Evaporation is an active source of electricity, and thus the clouds, which are made up of hollow vesicles of aqueous vapour filled with air, contain a considerable quantity of electricity stored up and ready to be discharged." Concerning the telephone, the author remarks that its "action appears to depend upon the principles of magnetism, electricity, and acoustics." Further quotation is needless.

Hydrostatics and Pneumatics. By Philip Magnus, B.Sc., B.A. (London: Longmans and Co. 1878.)

THIS work forms the seventh volume of the "London Science Class-Book Series," jointly edited by Prof. G. C. Foster and the author of the work before us. The books are intended for "school purposes," but we cannot imagine that the author of the "Hydrostatics and Pneumatics" can be acquainted with science teaching in schools, or its requirements, to judge of his treatment of the question of the relative densities of air at different heights (p. 125), or of the method of finding the difference of height of two stations by means of a barometer, supposing the temperature and force of gravity constant (p. 127). Or again, if we glance at pp. 18, 41, and 58, we perceive at once that the treatment is of far too complex a nature to be taught to young boys in Form who probably have one hour, or at most two, to devote to the subject in a week. For advanced boys in Upper Fifth and Sixth Forms the book will undoubtedly prove useful, provided they can devote several hours a-week in any one Term to the subject. The work is clearly written for the most part, and there are but few omissions. We do not notice, however, any mention of the experiments of Mr. Tomlinson and Prof. Van der Mensbrugge on surface tension, nor of the experiments of Venturi, Bernouilli, and Magnus, on the lateral action of a fluid in motion.

The Bulb Garden; or, How to Cultivate Bulbous and Tuberous-rooted Flowering Plants to Perfection. By Samuel Wood. (London: Crosby Lockwood and Co. 1878.)

IT is not too much to say that the best part of the present book is its cover. The binder has certainly performed his part well, and produced a pretty-looking book, but we must look no further than the cover for a word of eulogy. We have only to turn over the fly-sheet to read the title-page, and we are startled by an extraordinary gaudily-coloured plate, which suggests a design for a patchwork counterpane, but which, upon closer examination, turns out to be one for a bulb garden. With this we are not prepossessed; and the next coloured plate still further lessens our appreciation of the author's artistic taste. We leave the plates and turn to the text, in the hope of finding the literary character of the book such as to make amends for its artistic shortcomings; but still we are disappointed, for, when we find such plants as *Dielytra*, *Tritoma*, *Lychnis fulgens*, the Hellebores, &c., classed as bulbs, we are inclined to ask, Does the author know what a bulb is?

LETTERS TO THE EDITOR

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

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

American Exploration

North-western Wyoming and Yellowstone Park

THE letter from Capt. W. A. Jones in NATURE, vol. xviii. p. 667, seems to show a feeling of irritation on his part at the notice of his Report upon a reconnaissance in North-western Wyoming, which appeared in your columns some months ago. There was not in that notice any expression which could be interpreted into a want of recognition of the ability with which he had conducted the operations committed to his charge. Of course the desirability of these operations, and whether they were important enough to justify the expedition, are matters of opinion regarding which we may differ from Capt. Jones, without for a moment casting any reflection upon him. One object of the remarks which have displeased him was to point out the need of some central authority to control the various exploratory surveys in the United States, and prevent a needless expenditure of labour and money in the reduplication of work by parties operating without any concert with each other. This subject was brought before the notice of Congress, and a special committee was appointed to consider it and take evidence. The report of the sittings of this committee shows a most laudable desire of patiently getting at the truth. It recommends that the Engineer Department should not be authorised to undertake any surveys except such as might be required for purely military purposes. Of course, Capt. Jones, as an officer of engineers, thinks this a very "one-sided report." But the decision of the committee met with the approval of the great body of scientific men in America, whose only desire could be the best means of facilitating the thorough exploration of their great country. And the decision was equally welcomed on this side of the Atlantic by men who knew nothing and cared less for the personal bickerings of the different Government departments and surveyors in the United States. Capt. Jones speaks of a quotation made from the committee's report as being "out of the pale of decent characterisation." It was nevertheless the deliberate statement of men who gave their testimony upon oath. Strong expressions of this kind are apt to raise more than a doubt as to the strength of the cause in support of which they are adduced.

With every wish to do full justice to Capt. Jones and his associates, I feel that there is a far larger question behind his complaint than the mere recognition of their contributions to our knowledge of the North American Continent. To students of science in Europe it is a matter of small moment under what Government department or by what organisation of surveying parties the work of exploration is carried on. Most cheerfully do we recognise the labour, the patience, the courage, the physical endurance, the sagacity of observation, and the admirable powers of generalisation which during the last fifteen or twenty years have been bestowed by the various departments upon the task of unravelling the geography and the geological history of vast tracts of the United States. Thus the Department of Engineers has earned our lasting gratitude for the thoroughness and accuracy of its contributions; and had it no other record of its work than the magnificent series of quartos relative to the survey of the 40th parallel, that department would have raised an enduring monument of its scientific prowess. But besides the exhaustive reports of Clarence King and his associates, the Bureau of Engineers has issued many other most admirable volumes, not least among which is that of Capt. Jones himself. Then the Department of the Interior has for a number of years enjoyed the lustre shed upon it by the researches conducted by Dr. F. V. Hayden. Capt. Jones speaks of this distinguished explorer in the generous spirit of a true lover of science. To have succeeded as Dr. Hayden has done means not merely that he has conquered the physical difficulties of unexplored regions, that he has possessed mental powers capable of grappling with the many difficult problems presented by these western territories, that he has that judgment and *bonhomie* which have enabled him to select and keep round him year after year such a band of skilled observers as has included the names of Marvine, Peale, Endlich, and Gardner; but—what, perhaps, demands greater skill and patience than all the rest—that he has had the self-denial and courage to canvass the Congress, and literally persuade or coax its members into granting the necessary appropriations. It is all very well to talk of the dignity of science; but science cannot get on without money; and to get money she must, in America at least, "hiding her dignity in her necessity, be fain to shuffle, to hedge and to lurch." That a man of Dr. Hayden's powers should require to go through this annual penance is sad to think, but, as matters stand, he must either go through it or give up his explorations. He has chosen the former alternative. That in so doing he has done wisely must be granted not only as regards the prosecution of his own operations, but indirectly in reference to the other explorations sanctioned and paid for by Congress. The altogether admirable surveys conducted by Major Powell, for example, also under the Department of the Interior, have a powerful backing in the prestige of Dr. Hayden's work. The Coast Survey has long been a model of accurate and exhaustive methods of research.

Capt. Jones remarks that "in the cause of science a little duplication and reduplication are things not to be sneered at." A few lines further on he says that "exploring is but imperfect work, so far as the survey, which is its foundation feature, is concerned;" and that "observations for longitude with any known portable instruments are painfully erratic, unless there be abundant time." No one ever "sneered at" the repetition of surveys by different exploring parties; but every one, unless perhaps a candidate for future employment in these expeditions, must admit that it is a pity to reduplicate work which is so confessedly "imperfect" and "painfully erratic." Let the first preliminary surveys be made, but let them be done systematically, so that different surveying parties shall work in concert, and not blindly re-survey each other's ground. If any subsequent reduplication can be undertaken let it be again done methodically, with the view of correcting and filling up the first rough outlines. This requires some central controlling authority, and it is the absence of this authority which has led to the misunderstandings and dispeace. At present any man who can gain the ear of Congress, and get an appropriation of so many thousand dollars may go and explore as he pleases, and very much where he pleases, provided only he renders account to the Department of the Interior for the disbursement of the money. Of course this want of supervision leaves the explorer untrammelled by the official bonds which would hamper him if he were surveying in a longer-settled country. He is entirely his own master, can arrange his work and dispose his staff precisely as he judges best for the sake of progress and efficiency. No doubt these are enormous advantages. But then, on the other hand, he must stoop to button-hole the Congress-men, and spend many valuable weeks in getting them to see that they ought to continue, or even to increase their grants to him. He has no departmental organisation behind him on whose support he can rely, and the mere passive existence of which would often of itself be enough for his purpose. He must every year fight his own battle over again against competing organisations, rival explorers, and utterly indifferent members of Congress. It was in this respect that the Department of Engineers proved so formidable an antagonist in the conflict which led to the appointment of the Congressional Committee referred to by Capt. Jones. It is an organised department of long standing with traditions and military *esprit de corps*. The several explorers under its wing had not to stand each with his back to the wall fighting for his own. Their cause was taken up as a general one by the engineers and the army, and it was only after much evidence had been led that the Committee agreed upon that "one-sided" Report which the engineers naturally resent.

If all the surveying work undertaken, or at least paid for, by Congress, were placed under some central control, enough would probably be done were precautions taken to secure that the various operations were carried on in concert and not in utter ignorance of each other, and that the maps and memoirs were issued in some one general form which would facilitate reference. The various explorers need not lose their practical independence. They might remain as unhampered as ever, and be left free to make their own dispositions within certain general limits. Such a central board ought to charge itself with securing the necessary money grants from Congress, and thus save its scientific men from the degradation and loss of valuable time in personally canvassing the members. The gain to the explorers in this way would surely far more than compensate for any fancied loss of independence.

One word more about American exploration, and it shall be one of unqualified admiration. When a member of any of the branches of the public service in this country which are concerned with scientific publications contemplates the style in which such publications are prepared and issued in the United States, he finds a spirit of envy rising uppermost within him. Quarto after quarto, atlas after atlas, all published in the most sumptuous style as regards paper, printing, engraving, and chromo-lithography, are poured out from the American national press, yet at such prices as not to place them beyond the reach of all but the rich. The number of copies of these costly works actually distributed gratuitously is almost incredible. They are scattered lavishly over Europe, not merely to public libraries, but even to private students of science whose names are known to few of their own countrymen save those who read their writings in the scientific journals. Such open-handed generosity makes many a recipient of the gifts accept them almost with reluctance when he knows how little we in this country can offer in exchange. It is not that we are idle, or that the results of our labours would not furnish materials for important memoirs. But they manage these things better in the States. Perhaps we may profit by their example some day.

ARCH. GEIKIE

Discovery of a Scottish Crannog

WILL you kindly allow me, through the columns of NATURE, to draw the attention of archæologists to a recent discovery of an ancient crannog on the farm of Lochlee, near Tarbolton, Ayrshire. It appears that formerly a considerable portion of what is now arable land, and divided into several fields, was occupied by a loch with mossy banks and bottom, and that about forty years ago its outlet was deepened and its whole area completely drained. When this was done a small mound was observed near the outlet of the lake and about 100 yards from its nearest bank, which, from its artificial appearance and the discovery of two canoes in the bed of the lake, then attracted the curiosity of a few observant people in the neighbourhood, but led to no further result, and soon the whole affair was entirely forgotten. Just now the same locality is being re-drained under the direction of Mr. Turner, factor for the Duke of Portland, and his men, while engaged in cutting the main drain which happened to pass through a small bit of this mound, came upon the peculiar structure of the crannog. Fortunately this came under the cognizance of Mr. James Brown, Tarbolton, who wrote a note to Mr. J. Anderson, Keeper of the Museum of the Society of Antiquaries of Scotland, drawing his attention to this discovery. This gentleman immediately wrote to R. W. Cochran Patrick, Esq., of Woodside, Secretary of the Archæological Society for the counties of Ayr and Wigton, who lost no time in visiting the district, and at once recognised the nature and importance of the discovery. Meantime Mr. Turner and myself made several visits to the locality, in the course of which we observed that three rows of closely-set wooden piles, six feet apart, extended from the mound to the mainland—presumably forming the foundation for a wooden gangway. The tops of these piles, except in a very few instances, are below the surface of the soil. At the same time the men dug up a canoe, in a good state of preservation, hollowed out of one log, and tapering rapidly and uniformly at both ends. It was lying about 150 yards from the mound, and the highest portion of it was three feet below the surface. It measures ten feet long, two feet six inches broad, and one foot nine inches deep. It was then arranged that a careful exploration of the mound should be made, and accordingly systematic excavations were begun on Tuesday last, in presence of Messrs. Turner, Patrick, Anderson, Dr. McDonald, Ayr, and myself, and are now being prosecuted with great vigour and success. As a detailed account of whatever discoveries may be made, together with plans, sections, and drawings of the crannog, will be published in the Collections of the Archæological Society of this county, under the superintendence of its accomplished secretary, Mr. R. W. Cochran Patrick, it is unnecessary for me to give here more than a few remarks, just sufficient to convey to your readers some idea of what has already been done and may yet be expected. Guided by the tops of a few upright piles which just appeared on the surface, a broad trench was dug right round the mound. Some of these piles, all of which were formed of young oak trees, were found to terminate in holes in large horizontal beams, while others appeared to be driven into the muddy bottom and surrounded by thick planks of oak, young trees, and brushwood, amongst which beech, birch, and hazel were readily recognised. On the north-east side, and only about one foot below the surface, were two series of horizontal beams of oak from five to six feet long, and about five feet apart, each of which had two square-cut holes near its extremities, through which upright piles penetrated and were firmly fixed by wedges of wood. These mortised beams rested on round trees which lay horizontally but pointed in various directions. Conterminous with these beams and running towards the centre, there was a rude and very much decayed platform formed of rough planks and saplings lying on large beams of split oak trees. The oozing of water prevented the complete exposure of the mossy bottom on which this curious structure was reared, but it was ascertained to be from seven to eight feet below the present surface. In all the parts that were examined large stones were found interspersed with the woodwork, and the diameter of the foundations of the mound was estimated at about twenty-five yards. A trench was then dug across this circular area, and near the centre we exposed two stony pavements, one lying immediately above the other, the space between being 2½ feet thick. These pavements rested on a thick stratum of clay which extended for several feet all round, gradually thinning towards the rim, and, from the abundant remains of ashes, charcoal, and burnt bones, evidently formed fire-places. About two feet below the lower pavement another layer of clay, together with ashes, charcoal, &c., was observed, and though not yet excavated, we concluded that it must have been a third fire-place. Nearly on a level with this was a layer of chips of wood as if cut by an axe, and underneath this was a layer of turf with the heather part downwards. On pressing the spade still further down it struck a log of wood. The perpendicular height from this log to the top of the upper pavement was seven feet nine inches. All these fire-places were below the level of the water before the first drainage was made. As it is ascertained that previously there was no island to be seen, the whole island must have sunk very much since its original structure. Round these fireplaces were the remains of a series of seven or eight large piles with their bases cut flat and resting on the floor of the middle pavement or a few inches below it. These upright piles inclosed a somewhat circular area, with a diameter varying from ten to fifteen feet. The articles hitherto discovered in the interior of the mound consist of querns, hammer-stones, bone-chisels, and lance-like objects, a spindle-wheel, wooden implements like clubs or paddles, &c., deer-horns, some cut across and marked with holes and other markings, numerous boars' tusks, and a great assortment of bones and teeth belonging to various kinds of animals. With the exception of a singular three-pronged iron instrument found in the large drain outside the mound and a rusty piece of iron shaped like a door-handle, picked up very near the surface of the mound, not the slightest trace of either iron or bronze has been discovered. A piece of red pottery, said by a competent authority to be so-called Samian, found in the same drain and near the same spot as the iron implement above alluded to, and the half of a grooved bead of the size of a hazel-nut and covered with a greenish pigment, are the only fragments of pottery as yet brought to light.

Kilmarnock, October 21 ROBERT MUNRO

Power of Stupefying Spiders Possessed by Wasps

MR. ARMIT'S letter, from Queensland, on this subject (NATURE, vol. xviii. p. 642) is, to my mind, of great interest as showing that the habits of insects are the same at the antipodes as on our side of the globe. I was well aware that the spiders were stupefied (or paralysed) and not killed, and that the use made of them by the wasp was as a nidus for her ovum, and to serve as fresh provisions for her larvæ when hatched. Of course if killed they would be useless for this purpose. We have a wasp of similar habits, but he makes use, in the cases in which I have watched his operations, of the larvæ of the garden white butterfly, which are rendered passive and helpless, but not killed, in a similar manner.

I make alternative suggestions for further, and if possible microscopic, examination into the matter. First, are the wounds producing this insensibility inflicted with the sting, or by an ovipositor in the act of inserting the ovum? Is the egg in the case of the wasp, as with the ichneumon, inserted in the insect to serve by and by as food, or outside it, in the cell? If the latter, then the punctures are, no doubt, true stings; and I make the alternative suggestion that the wasp is guided by its instinct—as the larva of the ichneumon is when feeding—to select for attack parts of its victim not vital, where the injected acid produces insensibility or partial muscular paralysis, but not death. Because in the rare cases in which a wasp or bee struggling in a spider's web succeeds in stinging his captor, in anger and at random, the spider dies. May the observation made in your columns by a recent correspondent, on the self-administration, through the mouth, of the poison of the sting by wasps and bees under chloroform not point to a stupefying property in the acid when taken, as the natives of India take the poison of venomous snakes, into the stomach, and not directly into the circulation of the blood? There is good work here for an observer with patience and a good field microscope.

Bregner, Bournemouth, October 19 HENRY CECIL

A Fossil Plant—Misquotation

IN an article on a fossil plant from the Isle of Man, in NATURE, vol. xviii. p. 555, the following sentence is attributed, apparently on the authority of Mr. Leo Lesquereux, to my report on the Devonian and upper silurian plants of Canada: "that these fragments are probably originating in the upper silurian of Gaspé; that as they are found in the lower part of the limestone which underlies the Devonian Gaspé sandstone and become more abundant in the upper beds, this suffices to indicate the existence of the neighbouring land, probably composed of silurian rocks and supporting vegetation."

On referring to the report in question, I find that the original of this strange statement stands as follows:—

"These remains of *Psilophyton* occur in the lower part of the limestone, but are more abundant in the upper beds, and they suffice to indicate the existence of neighbouring land, probably composed of lower silurian rocks, and supporting vegetation."

I have no doubt that Mr. Lesquereux quoted from memory, and probably supposed that he was expressing my meaning, but an English writer should have referred to the original.

I may add that the specimen referred to in Mr. Binney's article does not exhibit the characters of my genus *Psilophyton*, which does not contain "fucoids," but land plants of the rank of acrogens, and of which not merely the external forms, but also the internal structures are described and figured in the report referred to. The plant in question much more closely resembles *Buthotlephis harknessii*, Nicholson, from the Skiddaw slates. J. W. DAWSON

McGill College, Montreal, October 5

Sense of Fear in Chamæleons

DURING the past summer I have kept five chamæleons in captivity, and have repeatedly observed their terror and rage when confronted with snakes. When a large Algerian chamæleon (*C. vulgaris*), now in my possession, perceives a common snake (*Tropidonotus natrix*) wriggling in his vicinity, he at once inflates his body and pouch, sways himself backwards and forwards with considerable energy, or walks rapidly away with his body leaning over in the direction furthest from the snake, opening his huge cavernous mouth, and hissing and even snapping at what he evidently regards as his natural enemy. At the same time his body assumes an almost instantaneous change of colour, and is quickly covered with a large number of small dark brown spots. It is curious that similar symptoms of fear and anger are displayed when a lizard (*Lacerta viridis*), or even a tree-frog (*Hyla arborea*) is exhibited to him. The climax of grotesque nervousness was, however, reached one day, when the sight of a child's doll produced the like effect; in this case, it is probable that the glass eyes of the doll, giving to it the appearance of life, were what caused this terror in the reptile.

R. MORTON MIDDLETON, Jun.

West Hartlepool, October 23

An Unusual Rainbow

OCTOBER 28 was a fine day with a brisk westerly wind blowing. At 2 P.M. a splendid well-defined nimbus cloud passed from north-west to north-east, about a mile to the north of this observatory, and rapidly driving away before the wind, left a large tract of cloudless sky behind it, the sun shining at the time. Suddenly at 2.12 P.M. a magnificent rainbow shone out most brilliantly across the blue space, the effect being exceedingly novel and charming. The veil of rain-drops forming the bow was so thin as to be invisible except near the zenith, where there appeared to be a thin cirrus. No rain fell on the observatory, and unfortunately there were no means of determining subsequently the area covered by the shower.

Eventually the rainbow faded away over the cloudless sky, and the 30° or so of the extreme eastern end which overlapped the receding nimbus shone out with a vivid brightness until it disappeared.

A secondary bow was not visible in front of the clear sky, but the violet band of the primary stood out with great distinctness, apparently separated from the remainder of the bow.

Kew Observatory, October 29 G. M. WHIPPLE

OUR ASTRONOMICAL COLUMN

A MISSING STAR.—There was a curious, and at the time suspicious, history attaching to an object, shining as a star of 9·10 magnitude, which was compared on several nights with the minor planet *Hygeia*, while under observation at Washington in the autumn of 1850. This star, which was designated *k* in a list published in Gould's journal, was missed by Mr. Hind, who reported the circumstance in a letter to Mr. W. C. Bond, of Harvard College, by whom the attention of Lieut. Maury, at that time superintendent of the Naval Observatory, Washington, was called to it. Mr. Ferguson having verified the disappearance of this object on August 29, 1851, a search was made for it on the assumption of it being a great planet exterior to Neptune; the reason for this assumption will be apparent from an inspection of the following positions, which result from the observations on three evenings:—

1850.	Washington Mean Time. h. m. s.	Right Ascension. h. m. s.	Declination. ° ′ ″
Oct. 16	6 52 36	19 17 42·81	−20 44 57·1
,, 21	7 6 40	19 17 42·19	−20 44 55·5
,, 22	6 35 35	19 17 43·90	−20 44 54·6

It was also observed on the 19th, but the accurate positions of the stars of comparison are not available. These observations appear to indicate that the object had motion in R.A., but that it was stationary at some time between October 16 and 22, and if we suppose it to have been a planet moving in a circular orbit, we find to allow of its being stationary at this elongation from the sun, its distance would be 49·94, and its period of revolution 351 years, or about twice the period of Neptune, and the period of Neptune is about twice that of Uranus. Notwithstanding the search was continued from August 29 to December 11, 1851, and extended to all stars of the eleventh magnitude between 19h. 20m. and 19h. 36m., and from −19° to −21° 20′, no planetary body was found. That the Washington observers considered suspicion to attach to the object is obvious, but the only likely explanation appears to be that there was a variable star in this position, and that the observations in right ascension were affected with greater error than might be expected, considering that on two of the days of observation several comparisons were made. To our knowledge search was also made in Europe for the Washington star. Further particulars will be found in two letters from Maury, published in Gould's *Astronomical Journal*, No. 36.

THE SATURNIAN SATELLITE MIMAS.—From some Washington observations of this difficult object between the years 1874 and 1877, it appears that the following elements may be taken as approximately representing the motion of the satellite in the interval on the assumption of a circular orbit in the plane of the rings: epoch 1878, January 1·0207 G.M.T., $u = 0° 0'$, $N = 126° 14'.5$, $I = 7° 3'.2$, radius of orbit at the mean distance of Saturn $27''.40$, period of revolution 22h. 37m. 5·614s., or the logarithm of the period in days = 9·9742473. The general run of the differences between calculation and observation, incident probably in part to a sensible excentricity, may be judged from the following results of comparison with a few of the observations made with the great refractor at Washington :—

	Pos. $(c - o)$	Dist. $(c - o)$		Pos. $(c - o)$	Dist. $(c - o)$
	°	"		°	"
1874 Sept. 2	+ 0·6	+ 0·28	1877 Aug. 11	+ 0·9	+ 1·13
,, ,, 26	− 2·6	− 0·54	,, Oct. 15	+ 0·5	0·00
,, Oct. 15	+ 0·2	0·00	,, ,, 16	− 1·2	...
1876 Oct. 13	+ 1·2	+ 0·45	,, ,, 17	+ 4·1	+ 1·86
,, ,, 31	− 1·3	+ 1·33			

From the above elements we shall find for the times of greatest elongation of Mimas eastward, 1878, October 31, at 10·4h., November 1 at 9·0h., November 2 at 7·6h., and November 3 at 6·2h., and at these times, the distance of the satellite from the centre of Saturn about 30".

GEOGRAPHICAL NOTES

ADVICES from Mr. John Carnegie, H.B.M. Consul at Loanda, of September 9 ult., give most encouraging news with respect to Mr. Heath's expedition to Angola. The young explorer had enjoyed excellent health and had just started on a six months' expedition up the River Bengo, proceeding to Galungo Alto, and, if his health permitted, returning by the Quanza River. The first small collection of birds has been received from Matamba, on the Rio Bengo, an account of which will shortly be laid before the Zoological Society by Mr. Bowdler Sharpe. As the result of a first month's collecting it is creditable, but the season of the year having been adverse, nothing of any striking interest is contained in it. More may be expected from the large case of specimens now on its way to England.

MANY attempts have been made to penetrate into the interior of Greenland from the west coast, but, until this summer, with little success. Three Danish gentlemen, Messrs. Jensen, Kornerup, and Groth, under the direction of the Commission for scientific exploration in the Danish colony, started to explore and survey the coast between Godhaab and Frederikshaab. Lieut. Jensen took advantage of the opportunity to make an excursion into the interior over the ice. The aim was to reach several mountain peaks rising out of the ice. The baggage was placed in three small sledges of the travellers' own, and the toilsome journey commenced on July 14. After two days the loose snow accumulated on the surface of the ice to such an extent that the journey became very dangerous, while they continually sank in concealed crevasses and holes, saving themselves only by adopting the Alpine expedient of attaching themselves to each other with a rope. The surface of the ice was generally undulating, but there were also many rugged parts and chasms, which rendered the journey a very difficult one. It was foggy nearly the whole time, and on July 23 a snowstorm came on. On the 24th the expedition reached the foot of the mountain referred to above. Then came on another storm which lasted for six days with continuous snow and fog; the travellers were snow blind. The weather cleared on the 31st, when the ascent of the mountain might be undertaken with some prospect of success. The height was estimated at about 5,000 feet above sea level, and on the other side of the mountain, as far as the eye could reach, ice sheets and glaciers were seen, and not the smallest speck of land free of ice. After finishing their observations the expedition returned, and reached their starting-point on August 5, having been away for twenty-three days. The mountain referred to was forty-five miles from the coast.

THE discovery of a new island in the Polar Seas is announced. E. Johannessen, who has just returned to Tromsö, reports that he penetrated a considerable distance to the east, beyond Novaya Zemlya. On September 3, in long. 66° E. and 77° 35′ N. lat., he discovered an island which he has named "Ensomheden" (loneliness). It is about ten miles long, and level, the highest point not exceeding 100 feet. It was free from snow, with poor vegetation, but an immense quantity of birds. The sea was free from ice towards the west, north, and south, but drift ice was seen towards the south-east. There was evidence that the Gulf Stream touched the west coast of the island; the Stream runs in a strong current round the north coast towards the south-east. Everything about the ice was favourable for navigation so long as the vessel did not go too near the mainland of Siberia. The newly-discovered island lies, therefore, somewhat to the south-east of the region visited by the Austrian expedition of 1873-4. It has been thought probable that a line of islands in the latitude of this island extends along the north coast of Asia.

NEWS has been received from Prof. Bastian, of Berlin, that he safely arrived at Bushire, on the Persian Gulf, *via* Teheran and Ispahan, and that he has thence continued his journey by sea.

LIEUT. SANDEBERG, whose explorations in the Kola Peninsula and the White Sea we have already referred to, has returned to Sweden with numerous zoological collections obtained during the past summer. Lieut. Sandeberg finds the coast-waters between Varanger Fjord and the White Sea extraordinarily rich in cod and whales.

THE *Deutsche Geographische Blätter* of the Bremen Society, No. 4, contains several items of interest, some of which we note separately. There is a long and valuable paper by Prof. Struder on a visit he made to Timor in 1875, and another on the results of the numerous voyages to Siberia made this summer, all of which have been so eminently successful that a regular summer trade-route to the great Siberian rivers may now be held as established.

THE *Bulletin* of the Geographical Society of Marseilles for July–August contains an interesting account of the little-known Island of Lamoo, on the African coast, a few degrees north of Zanzibar. The island itself is described, and a pretty full account given of its inhabitants and their habits.

A TELEGRAM from Hong-Kong states that the Chinese authorities are contemplating the construction of a railway from Taku to Tientsin, in order to facilitate communication with the capital and to avoid the difficulties to navigation caused by the tortuous course of the Pei-ho. A rumour from the north in regard to this scheme was published in the *North China Herald* of Shanghai, on August 10, "with all due reservation," as it appeared almost too good to be true. Our contemporary says that the plan is believed to have been agreed upon last year, but delayed in execution because it had been hoped that the plant of the condemned Shanghai and Woosung railway could have been made partly available for the purpose. This having been otherwise disposed of, it is said to have been now determined to purchase new plant throughout, and to press forward with the new line as quickly as possible. Mr. Tong Kingsing, a well-known Cantonese merchant, frequently employed by Li Hung-chang, who is said to be the prime mover in this matter, has been at the coal-mines in the north-east of the province of Chihli for some time, but he is expected to return to Tientsin shortly, when it is believed that immediate steps will be taken concerning the new line.

THE Society of Geography of Paris held its first meeting for the year 1878-1879 on Wednesday week, in its new hotel, Boulevard St. Germain, No. 194. The number of members present exceeded 200. M. Quatrefages, president of the Section Centrale, was in the chair, and gave an address, in which he congratulated his fellow members on the success obtained in the building of the lofty mansion in which they were assembled, which is at a little distance from the place where the Society was founded in 1821.

IN his just-published report to the Foreign Office on the trade and agriculture of French Guiana, Consul Wooldridge forwards some information of considerable interest in regard to the production of gold in that region. The quarter of Mana, hitherto unknown as a gold-producing territory, has, through the energetic endeavours of adventurers, been prospected, and is speedily being opened up; indeed, it promises to be one of the richest gold industrial quarters. The production of gold at a few hastily-established placers, in the month of March last year, gave 21,747 grammes of pure gold, and in April 39,662 grammes. It is to be feared, however, that the gold-workings here and in other parts where the precious metal is found to a large extent is having a disastrous effect on the general prosperity of the colony, for Her Majesty's Consul, quoting from the report of the Commission which periodically proceeds to the various quarters to inspect estates, draws a melancholy picture of the abandonment and poverty of agricultural property in French Guiana.

THE latest work of the leader of the Austrian North Polar Expedition, Captain Karl Weyprecht, entitled "Die Metamorphosen des Polareises," is now in course of publication at Vienna (Perles).

A CURIOUS statement appears in the foreign correspondence of the *Times*, that Russian papers state that the Amu-Darya has returned to its original bed. This may very well be the case without any or much interference on the part of man, as may be seen from Major Herbert Wood's articles on the Aral region in vols. xi. and xii. of NATURE. About twenty years ago the Loodon Canal at Bend, above the splitting up of the lower Amu, was dammed up. This canal seems to have been connected with the old course of the Amu into the Caspian, and a strong flood breaking down the dam might easily cause the river to resume its old course, especially as its present mouths seem to be gradually filling up with the abundant matter brought down by its waters. It is apparently at Bend that the deviation has taken place.

AN able review of Geography at the Paris Exhibition appears in the last number of the *Revue Scientifique*.

THE TELEPHONE, ITS HISTORY AND ITS RECENT IMPROVEMENTS[1]

I.

THE appearance of the two works mentioned below is indicative not only of the remarkable era of scientific invention through which we are passing, but also of the wide-spread interest in science which these inventions have aroused.

It will be noticed that neither of these works is published in England: one reaches us from America, the other from France. As a nation we are slow to appreciate the value of new inventions—a conservatism which arises less from caution than from popular ignorance of science; nor will an enlightened public opinion be possible until the first principles of science form an integral part of the education of every English boy and girl. But now that science is walking in the market-place, and holds its own on the exchange, ignorance of its elements becomes commercially perilous. A sound judgment on the value of a new scientific discovery may at any moment be indispensable to capitalists and very profitable to shareholders. We venture to say that such a conviction has been a prevalent idea on almost every stock exchange during the recent panic in gas shares. Scientific knowledge has presented itself in a new light: it is now a commercial article; and forthwith the British public promptly recognises its value. In fine, the business aspect of recent inventions may do more for the future extension of science teaching than years of earnest expostulation.

The two works before us cover nearly the same ground. They give the history of the invention of the telephone, the methods that have been devised for electrically transmitting and receiving speech, with the most recent improvements down to a month or two ago; they also describe the phonograph; and Prescott's book, while omitting the microphone, which is fully discussed by Du Moncel, devotes its concluding chapters to quadruplex telegraphy, electric call-bells, and electric lighting.

Of the two works Count du Moncel's is the more scientific, comprehensive, and impartial, and will add to the high reputation which its indefatigable author already possesses as the historian *par excellence* of the applications of electricity. We can therefore most heartily commend this treatise to our readers; it is, moreover, well printed, capitally illustrated, and withal published at a very low price.

Mr. Prescott's work is larger, the typography and illustrations are excellent, and in technical details and recent information it leaves nothing to be desired. The arrangement, however, is confusing. The body of the work consists almost wholly of reprints from the various papers, lectures and specifications of the workers at electric-telephony, and the absence of marks of quotation with the want of proper indication where one extract ends and another begins not only puzzles the reader but is apt to give rise to serious misapprehension. The work has obviously been hastily prepared for the press, repetitions are frequent, and the matter is arranged with little regard to the reader's convenience or to chronological sequence. Moreover, its author has an evident bias towards American inventions in general and the "Western Union Telegraph Company" in particular. It is true the work professes to deal with speaking telephones only, but as some American "tone telephones" are described in detail, we are surprised at the entire omission of the early and important telephonic experiments by Cromwell Varley in London, and afterwards by La Cour in Copenhagen.

Nevertheless, with all its defects, Mr. Prescott's book is a useful and needed contribution to scientific literature, and as each inventor is allowed to speak for himself, the careful reader is enabled to form his own judgment on certain disputed questions of priority of invention.

It is time that the history of the articulating telephone was written. Hitherto the English public have had little more to guide them on this subject than the lectures given in London by Prof. Graham Bell, lectures delivered with altogether admirable grace and diction. It is very natural that an inventor should give more prominence to his own ideas than to those of others, and hence the impression generally derived from Prof. Bell's lectures is that the sole credit of the first conception and successful construction of the articulating electric telephone is due to himself. There were, however, other workers in the field of electric-telephony besides Mr. Graham Bell, and it is to be regretted that Prof. Bell did not give sufficient prominence to this fact in his discourses. Mr. Prescott, indeed, brings some serious charges against Prof. Bell, asserting that to another American, Elisha Gray, of Chicago, is due the entire priority and merit Bell claimed for himself. Here is what Mr. Prescott says:—

"It was not till after Prof. Bell had substituted the apparatus shown in Mr. Gray's *caveat* that he was enabled

[1] "The Speaking Telephone, Talking Phonograph, and other Novelties," by G. B. Prescott. Illustrated. (New York: Appletons, 1878.)—"Le Téléphone, le Microphone, et le Phonographe," par Le Comte Th. du Moncel. (Hachette, 1878.)

to successfully accomplish the grand object of reproducing articulate speech at a distance" (p. 73).

A little further on Mr. Prescott remarks:—

"From the reading of the text [Prof. Bell's lecture in London] it might be erroneously inferred that the apparatus shown [a water variable-resistance telephone] was invented by Prof. Bell, and exhibited by him at the Centennial Exhibition. Prof. Bell neither invented nor exhibited it. The figure [given by Bell] represents the transmitting portion of Elisha Gray's original speaking telephone, the first articulating telephone ever invented. Mr. Gray experimented with the telephone at the Centennial Exhibition in America in 1876, and showed it, among others, to Prof. Barker, but did not exhibit it to the judges."

Even with reference to the present shape of Bell's telephone, Mr. Prescott denies that Bell was its inventor and he adduces evidence to show that the present portable form of the handle telephone was due to Dr. Channing and Mr. Jones, of Providence, R.I. This, however, is a minor matter, but the question of priority of invention of the principle of the articulating telephone is one of general interest and importance.

To the consideration of this matter the Count du Moncel brings not only an independent and unbiassed mind, but also a profound technical and historical knowledge of the various applications of electricity. And in the following opinion, which he expresses, we entirely agree:—

"Si M. Bell a été le premier à construire et à rendre pratique le téléphone parlant, M. Elisha Gray avait le premier conçu le principe de cet instrument et l'avait combiné en electricien consommé."

A similar opinion is expressed in a very able and lucid discourse by a well-known electrician, Mr. F. L. Pope, delivered last December before the American Electrical Society at Chicago, reprinted in Prescott's book. At the same time we must bear in mind Prof. Graham Bell had for some time back also been at work at a similar problem to that which had led Gray to the conception of an articulating telephone, namely, the problem of multiple telegraphic transmission by means of harmonic vibrations, and from this subject was led to the discovery of his magneto-electric telephone. As Mr. Pope remarks, "when we consider that each was working in ignorance of the labours of the other, the singular coincidence in the results they finally obtained is not a little remarkable." To Gray and Bell a third name has also to be added, namely, that of Edison, to whose work we shall refer more fully in another article. These three names stand conspicuously forth in connection with the discovery of the speaking telephone, and we therefore propose to trace the relationship each bears to this subject.

The dominant idea that stimulated each of these inventors was the possibility of transmitting several messages simultaneously along one wire. By his patent of 1870 Varley had led the way to the method by which this could be accomplished; he succeeded, in fact, in transmitting secondary currents, generated by the vibration of a tuning fork, in the primary circuit of an induction-coil, concurrently with the ordinary Morse signals, the former not sensibly affecting the usual electro-magnetic receiving apparatus, but producing audible signals on a peculiar receiver of his own. After this, in September, 1874, La Cour, of Copenhagen, patented an apparatus for multiple transmission, founded on a modification of Varley's plan. In this case the receiver was a tuning-fork, controlled by an electro-magnet, and tuned in unison with the transmitting fork, hence it was capable of being thrown into sympathetic vibration by the electric waves started by the latter. A series of such duplicate forks was employed corresponding to the notes of the musical scale, and it was found that the intermittent currents of several of these forks could be simultaneously transmitted without confusion, each receiver selecting and vibrating under its appropriate system of electro-magnetic impulses. Early in 1875 Gray, of Chicago, patented a somewhat similar, but more perfect arrangement. Gray's caveat, or application for his patent, dates from August, 1874, so that in point of fact he anticipated La Cour's method. Instead of using tuning-forks Gray employed strips of steel as being lighter and more sensitive; each transmitting reed instrument had, of course, its fellow at the receiving end, which promptly responded to its own system of waves, acting upon it through an adjacent electro-magnet.

The idea of synchronising the movements of two instruments at wide intervals apart by employing the principles of isochronous vibration is not novel, it was carried out by Helmholtz in his experiments on vowel sounds; and still earlier distant isochronous pendulums were used in telegraphy to control machinery, by Vail, in 1837, Ronalds in 1861, and Hughes in his printing-telegraph. But Gray accomplished more than this. Reiss, in 1862, had shown by his telephone how the *rate* of vibration might be electrically transmitted and reproduced, but the amplitude and mode of vibration were lost; Gray, towards the close of 1874, discovered a method whereby the proper *amplitude* of each vibration or combination of vibrations could be reproduced, "by causing the effective strength of the electric current, by which the transmission is

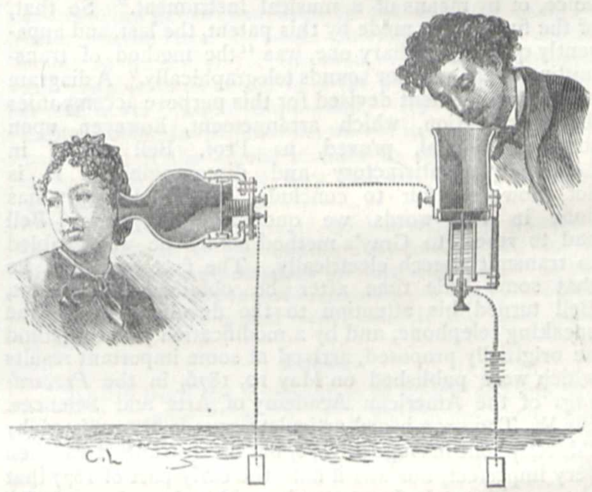

FIG. 1.—Original arrangement for the electric transmission of speech designed by Gray. A current from the battery on the right passes into a vessel containing water, into which dips a wire attached to the vibrating membrane and in circuit with the line. (From Du Moncel's work.)

effected, to rise and fall with the varying amplitude of the sonorous waves which are to be reproduced." Hence, as Mr. Pope, in the discourse to which we have alluded, goes on to remark:—"This having been accomplished, it was not difficult to foresee that two practical applications might be expected to follow, namely, multiple transmission and vocal transmission."

There yet remained however the difficulty of impressing upon an electric current the rapidly-changing *forms* of the sonorous waves which occur during the act of speaking. In the beginning of 1876 Gray conceived the idea of accomplishing this by attaching to a stretched membrane, such as was used by Reiss, an arrangement whereby the movements of the membrane should produce proportional alterations in the resistance of an otherwise constant electric circuit. Undulatory currents of fluctuating strength would thus be set up by the voice, and these, acting electro-magnetically upon a diaphragm at the far end—to which was attached a piece of soft iron—would cause it to be thrown into vibrations corresponding to those existing at the transmitting end. The problem of the transmission of speech was thu theoretically solved. On February 14, 1876, Gray registered this invention at the American Patent Office, under the title of "a means of transmitting and receiving vocal sounds telegraphically," and in his caveat he gives an exact drawing of the method he adopts, and which we here reproduce.

Curiously enough, on the very same day, there appears the first documentary evidence on behalf of Prof. Graham Bell, and this, too, is for a patent granted to Bell—not, however, for the electric transmission of speech, but "for certain new and useful improvements in telegraphy." These improvements consist in the employment of *induced* undulatory electric currents, and form one of the numerous practical applications of Faraday's famous discovery of magneto-electric induction. By the approach and recession of the prongs of a magnetised tuning-fork, or by the oscillation of a magnetic diaphragm, alternating currents were generated in an adjacent coil of wire. This is the essence of Bell's patent, the advantages claimed by the use of such undulatory currents being increased speed of telegraphy and the possibility of multiplex telegraphy. Nothing is said about the transmission of speech till near the end of the specification, when it is stated that "one of the ways in which the armature may be set in motion [to generate these currents] is the wind. Another mode is the human voice, or by means of a musical instrument." So that, of the five claims made by this patent, the last, and apparently quite subsidiary one, was "the method of transmitting vocal or other sounds telegraphically." A diagram of the arrangement devised for this purpose accompanies the specification, which arrangement, however, upon subsequent trial, proved, as Prof. Bell stated in London, "unsatisfactory and discouraging." It is not, however, fair to conclude, as Mr. Prescott has done in the words we quoted earlier, that Bell had to resort to Gray's method before he was enabled to transmit speech electrically. The fact seems to be that some little time after he obtained his patent, Bell turned his attention to the development of the speaking telephone, and by a modification of the method he originally proposed, arrived at some important results which were published on May 10, 1876, in the *Proceedings* of the American Academy of Arts and Sciences. Sir W. Thomson heard articulate sounds transmitted by this telephone in August, 1876, but the instrument was then very imperfect, nor was it until the early part of 1877 that the speaking telephone may be said to have been a *fait accompli;* in May, 1877, it was successfully tried between Providence and Boston, places forty-three miles apart. There seems reason to believe that the important improvement of the substitution of permanent magnets for electro-magnets was made at the suggestion of Prof. Dolbear, and that Professors Peirce, Blake, Channing, and others contributed valuable modifications of the original design, until the Bell telephone assumed its present simple, elegant, and handy shape, growing in efficiency as it diminished in size and complexity.

Thus it will be seen both Gray and Bell can fairly claim the discovery of the principle of the articulating electric telephone. Gray solved the problem first theoretically, Bell first practically; the former proposed to vary the resistance of the circuit without changing the electromotive force; the latter varied the electromotive force without changing the resistance. And although Gray's method was only partially successful in operation, owing to his employing an electrolytic resistance, it is a method capable of yielding more striking results, owing to the use of more powerful currents. But where Gray failed, Edison has succeeded, and in another article we propose to trace the connection of this remarkable inventor with the subject of electric-telephony, up to his splendid discovery of the carbon telephone.

W. F. BARRETT

COLOUR BLINDNESS IN RELATION TO THE HOMERIC EXPRESSIONS FOR COLOUR[1]

II.

SO far as I can follow Mr. Gladstone's investigations, it appears to me that Homer has exactly fulfilled all the conditions mentioned in the previous article. As many references are made to natural objects which have the same colours now as they had in his time, I am able, with my colour-blind experience, to judge what sensations they would present to his eyes, supposing him colour-blind, and I can thus form a judgment of the appropriateness and consistency of his descriptions on that hypothesis. I can clearly trace the existence of two groups of epithets, which, so far as I can see, are kept fairly distinct, and the words in which are never mixed up with the ideas belonging to the contrary group. The epithets are—

For the group of the yellow sensation: *ξανθός, ἐρυθρός, φοίνιξ, ῥοδόεις, χλωρός, κυάνεος*, and perhaps *οἶνοψ*.

For the group of the blue sensation: *πορφύρεος* and *ἰοειδής*.

For neutral sensations, irrespective of the words *λευκός* and *μέλας* (which may be left out of consideration altogether, the use of them being normal, and the vision of the colour-blind in regard to them being normal also) there is the epithet *πολιός*, on which an important element of the argument hangs.

We will now take these various words *seriatim*, and compare what Mr. Gladstone says of their application with the use that might be expected to be made of them by a colour-blind writer.

Ξανθός.

Liddell and Scott's translation of this word is "yellow of various shades, often with a tinge of red, chestnut, auburn." Mr. Gladstone (N. 380) considers it, as used by Homer, to be a true word of colour, and that its applications are especially consistent.

It is used principally for human hair, and to the colour-blind *all* varieties of hair, except such as is positively jet-black, appear shades of yellow. Fair or golden hair is a light yellow, red and auburn hair are deeper tones, more intensely coloured, and all varieties of brown are darker still.

The word is also used for the colour of horses. All the varieties of chestnut and bay are to the colour-blind dark yellow, a yellow brown, the former of a lighter, the latter of a darker shade.

Ἐρυθρός.

This is, I suppose, the most usual Greek word for red.

Mr. Gladstone (N. 375) takes it to be the best approach to a true genuine colour-epithet, but at the same time he remarks how strange it is that Homer's idea even of red does not seem to be wholly distinct.

The difficulty, however, vanishes if we suppose Homer to have been in the position of the colour-blind, to whom, as I have explained, the proper idea of red is unknown. The word, according to Mr. Gladstone (N. 375, H. 460), is applied to copper, nectar, wine, and blood, all which, though they may differ in appearance to the normal-eyed, present to the colour-blind only different modifications of the yellow sensation.

In regard to blood, the hue varies according to its condition, arterial blood differing materially from venous blood in its colour. I believe that normal-eyed people hesitate to recognise any yellow element in it in any condition, but it is quite certain that when bright and freshly-oxygenated, it presents a sensation of yellow to me; and this is consistent with the fact that its colour is said to be chiefly due to the oxygenation of the iron it contains, the peroxide of iron being to me very positively yellow.

I conceive it may be possible that in this, as in many

[1] Continued from p. 679.

other cases of red, the yellow element may really be there, but may be so overpowered, to the normal eye, by the more vivid red sensation as to be undistinguishable to them, whereas to me, who am free from such interference, it is distinctly visible.

When blood is in the venous state it alters its colour, losing the yellow and acquiring the blue; and I believe normal-eyed people admit the existence of the blue element in blood of this kind. This fact will be found of importance in a subsequent place.

Mr. Gladstone adds:—"The favourite use of the word is for wine; this is very remarkable, because wine is not of a redness proper, but only approximative, and with a decided infusion of the idea of darkness." He also notices its application to the dark hue of red sandstone rock, and sums up by saying that the word is, in the great majority of instances, associated with dark rather than with bright. This is quite in accordance with the darkening idea of red that pervades the colour-blind theory.

Φοίνιξ.

This word is translated by Liddell and Scott, "a purple red, purple, or crimson." It is used very frequently by Homer, and Mr. Gladstone (N. 372, H. 463) finds many difficulties from its being applied to colours materially different from each other. If, however, we test his examples by the dichromic perceptions, we shall find all the difficulties disappear.

The first application is to blood; and in this case the word would appear to be synonymous with *eruthros*, and is justifiable on either the normal or the colour-blind principle.

But it is also applied to the colour of a horse, who was *phoinix* all over except a white spot on his forehead. Mr. Gladstone says that the same epithet sits very ill upon blood and the colour of a horse, whether bay or chestnut; and no doubt this is true as far as normal-eyed people are concerned, inasmuch as the equine hues contain, I am told, a much larger amount of yellow, being, in accurate colour terms, different varieties of orange-brown. But to the colour-blind these present only their yellow element, and since it is by that same element that arterial blood is recognised, there is no incongruity in the person describing both by the same term. It is curious that, whereas in the case of blood *phoinix* is used as a synonym for *eruthros*, in the case of horses it is used as a synonym for *xanthos*—a strong presumption in favour of the *grouping* I have insisted on—the combination being justified through the common element of yellow.

Phoinix is also used for the back of a dragon or serpent, for jackals, and for the skin of a lion. The lion is, even to normal-eyed people, exactly my colour, yellow brown, and the jackal, though grey or variegated on the back, has much of the same hue about him. I never saw a dragon; but snakes vary much in colour, and at least half the varieties at the Zoological Gardens convey to me a positive impression of yellow.

A compound of the word is also applied indirectly, by a comparison with the serpent (H. 476) to the rainbow. For the explanation of this, see the word *porphureos* farther on. It is also applied to cloaks or mantles, which Mr. Gladstone concludes were not red, as Homer never applies to them the more positive epithet for that colour. As we do not know what hue they were, we cannot reason on this application: it is sufficient for my purpose to assume they may have been some of the many varieties of colour which would give the yellow sensation to the colour blind.

It is applied to the bows of ships, which are known to have been painted with some kind of red colour.

If the word *phoinix*, used in *Od.* vi. 163 to mean the palm tree, has any connection with the colour epithet, as Mr. Gladstone appears to suggest, it furnishes a startling addition to the proof of the colour-blind theory. The confusion of red and green is incomprehensible to the normal-eyed, but it is one of the best-marked symptoms of the dichromic malady. *Phoinix* to me would just as correctly represent the leaves of a palm as it would arterial blood, a chestnut horse, or the skin of a lion.

It is clear, therefore, that we have only to suppose *phoinix* to be one of a group of words, all representing the colour-blind sensation of yellow in some of its varied shades and tones, and the whole of these apparently strange and anomalous applications become natural and justifiable. Indeed, Mr. Gladstone (H. 455) notices the anology with *xanthos*, and remarks that *phoinix* appears merely to "render other words."

Ῥοδόεις.

Referring to the rose; rosy. In noticing the use of this word, Mr. Gladstone (N. 376) at once seizes on the remarkable fact that, although the redness of the rose is so obvious, yet "there is no direct point of contact between Homer's expressions taken from the rose, and *eruthros*, as they are never applied to the same objects."

But this is perfectly in accordance with the sensations of the colour-blind. It was pointed out long ago by Dalton, and I took some trouble to explain the fact scientifically in my paper, that "Crimson and pink (rose colour) appear to have no relation to the idea of red derived from vermilion or a soldier's coat;" and if the colour-blind person has been in the habit of using *eruthros* for the latter it would do violence to his sense of colour to use it also for the rose. This flower, beautiful and positive as its colour is to the world in general, gives to me a very vague impression. Its characteristic of redness being invisible to us, we see in most cases only a pale grey; if the colour inclines to scarlet this will be tinged with yellow; if very crimson it will be tinged with blue.

Mr. Gladstone (N. 376, H. 469) is naturally puzzled by the application of the epithet rosy to olive oil, but the above explanation disposes of the difficulty. I have certainly heard my friends describe as "rosy" objects which to my eye would fairly match the pale yellow of oil.

Κυάνεος.

This is a word the explanation of which appears to be involved in much difficulty. It is said to mean the colour of a substance called *kuanos*, but what this substance was, or even what its colour was, appears open to much doubt.

The usual translation of the adjective, according to Liddell and Scott, is "dark blue" (whence the chemical term *cyanogen*), and there is no doubt that, in later Greek, it acquired significations positively identified with this colour. Mr. Gladstone, in 1858 (H. 496), discussed the meaning of *kuanos* at much length, and thought it most probably referred to a native blue carbonate of copper, an interpretation in accordance with its subsequent use and description as a colour. If, therefore, this meaning were adopted, the word *kuaneos*, conveying a distinct idea of blue, could not be included in the same group with *xanthos*, *eruthros*, and *phoinix*, which all, as we have seen, belong to the opposite sensation.

But Mr. Gladstone, after reconsideration, appears, in his later article (N. 378, &c.), to have altered his view. He now considers it "almost certain that *kuanos* is bronze," and *kuaneos*, either "made of, or in hue like bronze." This implies the abandonment of the idea of blue as connected with the adjective; for, so far as I know, there is not a vestige of the blue element in the colour of any combination of copper and tin. In any case, however, there is no doubt that a very dark hue is referred to.

Now the impression conveyed by bronze to the colour-blind eye is very dark, almost black, but with a tinge of dark yellow-brown; and keeping this in mind, if we review the various applications of the word given by Mr. Gladstone (N. 378, H. 462), we shall find nothing inconsistent with this explanation. It is applied—

To eyebrows, to hair, and to the coat of a horse, in any of which cases a very dark brown may be shown.

To a dark cloud, which may be of the same hue.

To the serried mass of the Greek and Trojan armies. "The colour of these," says Mr. Gladstone, "must have been derived from their arms, and these would probably be composed in the main of two elements, firstly copper, which is ruddy, and secondly, the hides of oxen upon the shields and elsewhere." He notes that to a normal eye the colours of these are not easy to combine in a common idea:—but to the colour-blind the combination is homogeneous enough; they both look dark yellow-brown, and the appearance is quite in accordance with the interpretation of the word *kuaneos* according to Mr. Gladstone's later view. When in 1858 he appeared generally to favour the blue interpretation he remarked justly that it could not hold in this instance.

To a very black mourning garment. But the blackest dyes have almost always some leaning either to brown or blue, and the use of another word instead of *melas* might possibly imply this leaning, without diminishing the intensity of the shade.

To the sea-sand, just left bare by the water, also yellow-brown. Here again the idea of blue seems inapplicable.

To Amphitrite, or the sea beating on rocks. The *deep* sea is dark blue or dark green; but its appearance close to the shore in shallow places may be so indefinite, that no positive inference can be drawn from this use of the term.

To the prow of a ship; this, we know by other passages, was painted with red earth or ochre, and if dark would appear the colour here implied.

We have here exhausted Mr. Gladstone's list of instances where this difficult word is used clearly as a colour-epithet. They are all perfectly consistent on the colour-blind hypothesis, clearly pointing to the classification of *kuaneos* in the yellow group; for, so far as I can judge, there is not a single instance where its application *necessarily* implies the idea of blue.

Mr. Gladstone remarks (H. 465):—

"The uses of this group of words (*i.e.*, the group formed from *kuanos*) thus appear to exhibit a degree of indefiniteness hardly reconcileable with the supposition that Homer possessed accurate ideas of colour; there is no one colour that can cover them all." This is true; but only suppose him dichromically colour-blind, and the dark yellow-brown hue he may call *kuaneos* will cover every example where he has used the term.

Χλωρός.

I suppose no doubt is entertained that this word, derived from *chloē* (young herbage), means, and always has meant, green, one of the most plentiful colours in nature, and one of the most positive and distinct to persons with ordinary eyes.

Now Homer's use of the word affords one of the strongest arguments as to the identity of his sensations with those of the colour-blind. Let us see the testimony which Mr. Gladstone offers to this fact. After quoting (H. 467) the application of the word to a pale face, to fresh-pulled twigs, to honey, to an olive-wood club, and to the nightingale, he remarks:—

"Upon the whole, then, *chlōros* indicates rather the absence than the presence of definite colour. If regarded as an epithet of colour it involves at once a hopeless contradiction between the colour of honey on the one side and greenness on the other. Again, the more we assume it to mean green the more startling it becomes that it could have taken paleness, as is manifestly the case, for its governing idea. . . . . The idea of green we scarcely find, unless once, connected with this word in the poems of Homer; and yet it is a remarkable fact that there is no other word in the poems that can even be supposed to represent a colour, which not the rainbow only, but every-day nature, presents so largely to the eye."

Again, in the later article Mr. Gladstone says (N. 380; the italics are mine):—

"It is plain, from the applications of it, that green was not on the list of Homer's colours. If I am to choose an English equivalent for the phrase it will be pale; and pale is not properly an epithet of colour so much as of light, although *there may perhaps be detected in it a very faint inkling*, so to speak, *of yellow*. If we strive to give the sense of colour we find there is none that will cover them in common, *yellow suiting in some cases*, green in others, neither of the two in all."

Speaking further of the application of *chloreïs* to the nightingale, he adds:—

"The balance of authority attaches the phrase to the hue or aspect of the bird, and, when so attached, it loses all definite idea of colour. . . . . Evidently enough, Homer's idea in this matter could not but be most vague and dim."

I have quoted these passages in order to show what a remarkably apposite commentary they offer on my own words, written twenty years ago.

"Green is a colour most perplexing to the patient, who cannot be said to manifest any definite sensation about it at all." It would scarcely be possible to give a more appropriate description than Mr. Gladstone has given of the impressions of the colour-blind in regard to green, although in all probability he knew little or nothing of these when he wrote the passages in question.

I have already explained how this arises, theoretically, from the invisibility of green proper to the colour-blind, and the appearance of green objects to them under false colours. As a matter of practice I have felt, throughout my life, that this colour has been my greatest stumbling-block, in regard to which my ideas and expressions have gone most astray.

In order to guess how a colour-blind person would be likely to use the term, we must bear in mind the fact, already stated, that the majority of greens in nature appear to him as varieties of yellow; chlorine gas, for example, which takes its name from the Greek word, is a decided yellow to me. And further, it is a fact within my own experience that, unless very powerfully coloured, such yellow greens have mostly a pale, washed-out appearance; indeed, if I find that a new object presents to my eye a sickly pale tint of yellow, I often make a successful chance shot in calling it green.

Keeping these explanations in mind, Homer's applications of the word appear quite natural.

The idea of paleness I have, I think, sufficiently explained. A pale face appears to me just such a sickly yellow as I have described.

I do not exactly know what the "fresh twigs" pulled by Eumæus to make a bed for Ulysses would be like, but they would probably be either green or brown, both which present to the colour-blind shades of yellow.

Honey, a pale yellow, is a perfect match to my eye with varieties of yellow green.

The club of the cyclops would be the colour of the bark of the olive tree, which is, I believe, a brownish grey, and would still be in the dark yellow category to the colour-blind.

The application of the term to the nightingale will naturally puzzle the normal-eyed, as the bird has nothing green about him. But he is described (N. 381) as a compound of tawny, olive, brown, and ash colour; and all these, except the last, which I do not quite understand, convey to the colour-blind the impression of modified yellow, by which chiefly they know green.

Οἶνοψ.

Wine-coloured. Homer (N. 377, H. 472), in speaking of wine, uses (omitting *aithops*, which, Mr. Gladstone thinks, may refer more to sparkling than to colour) two epithets: *eruthros*, red; and *melas*, black. This is consistent enough with ordinary usage, as the red wine in the south of Europe often is very dark, and is called *vino nero*.

To the colour-blind, if red wine is moderately coloured it appears a dark yellow-brown, but when very dark the yellow element may disappear, being overpowered by the blue in the purple, when the impression is simply black, as to the normal-eyed. I frequently see strong red wines in which I can distinguish no colour at all.

Homer uses the word *oinops* for oxen, which, if a dark ruddy brown, would present to the colour-blind the same hue as red wine.

He also uses it for the sea, under special associations which seem to indicate darkness, as, for example, "under a rattling breeze at night." In such a case the sea would show no colour, and the term might be merely a poetical simile drawn from the *vino nero*.

We now come to the opposite group of colour-epithets, applied to objects which give to the colour-blind a sensation of blue; this group, in accordance with the comparative rarity of the impression it denotes, comprehends a less variety of words, being limited to two.

The most important is

Πορφύρεος,

which, I suppose, may be translated purple.

This word, with its compounds, has, Mr. Gladstone says, the largest and most varied application in Homer; he considers its use peculiarly embarrassing, and dwells (N. 373-4, H. 461) at considerable length on the anomalies it presents.

He states that Homer's uses of the word imply three very different forms of colour, namely, red, purple, and grey, and no doubt, to the normal-eyed, these are incongruous enough; but, when we consider the terms under the colour-blind aspect, the incongruities disappear.

The second colour appreciable to the dichromic vision is *blue*, and a great number of different hues in nature, which happen to contain blue in their composition, appear to the colour-blind as varieties or shades of this colour. For example, many crimson hues of red, verging towards violet, contain blue, and, being darkened by the red, show dark shades of this colour. Purple or violet is a still bluer compound. All blue-greens appear blue, and, in regard to dark greys, they often have blue in them, or at least give a blue impression.

Now assuming the poet to have dichromic vision, I suppose *porphureos* would be the most likely word in Mr. Gladstone's list to represent his idea of the various shades of blue; and it is easy to recognise its applications in this way by the examples given (N. 373, H. 461). Omitting the metaphorical uses of the word, we find it applied:—

To various articles of clothing and furniture, which might be of many colours, all conveying the sensation of blue.

To the rainbow. I have, in my paper, fully explained the appearance of the solar spectrum; it presents two colours only, the less refrangible part appearing yellow, the more refrangible part appearing blue. Hence a colour-blind person in speaking of the rainbow may correctly use either term. Homer appears to use both, for in another place he compares the rainbow to a dragon or a serpent, for which he uses the words *daphoinos* or *kuaneos*, both, as we have seen, belonging to the yellow category.

To blood. Under the word *eruthros* it has been pointed out that blood, when venous, loses what yellow element it possessed and by tending towards purple shows a blue impression to the colour-blind. This will account for the mention of blood in this class.

To a dark cloud. The prevailing hue of dark clouds is, both to the normal-eyed and the colour-blind, grey. But this grey may, by atmospheric causes, become tinged either with brown or with blue; the former case has been noticed under the word *kuaneos*, the latter comes in here.

To waves and to the darkening sea. The beautiful blue colour often seen in the Mediterranean is notorious, and to me, at least, it has been particularly marked in the darker aspects of the water.

To death. So far as this application of the colour epithet may be literal, it may be explained by the fact that the livid hue of a corpse has to the colour-blind a decidedly blue tinge.

Ἰοειδής.

Violet-coloured. This epithet clearly belongs to the blue group, for the colour violet is a compound of blue with red, and to the colour-blind eye the blue element alone is visible, the red addition having merely the effect of giving a dark shade. Hence the word may be used by them consistently enough for all impressions of darkened blue.

It is applied by Homer:—

To the sea, for which, on the colour-blind view, it is equally appropriate with *porphureos*.

To iron, which is both to the normal-eyed and to the colour-blind a bluish grey.

To wool, which Mr. Gladstone (N. 380) thinks may have been dyed to a deep purple.

To living sheep (H. 471). This application is not so intelligible, as, so far as I recollect the appearance of black sheep, their colour has inclined rather to brown than to blue. The word, however, used here is a compound one, *iodnephes*, meaning, according to Liddell and Scott, "violet-dark," and it may possibly refer to that variety of dark violet I have before mentioned, in which the blue tinge is indistinguishable. There would seem to be a certain analogy here with the use of *oinops* for the black sea.

Mr. Gladstone includes among his adjectives one which I call neutral, *i.e.*, used for objects which do not convey to the colour-blind either of their two colour sensations. This is

Πολιός,

usually translated grey or hoary. Mr. Gladstone says (N. 381, H. 466) it is applied to the human hair in old age, to iron, and to the hide of a wolf, in all which cases grey is a fair interpretation.

But it is also a stock adjective for the sea, being used for it in no less than twenty-four places. Now the standard colour of the sea (the blue being exceptional) is, I am told, green, and I know by my own observation that the particular hue of green is just that which is neutral to the colour-blind, thus appearing grey. It is possible that the word, in the sense of "hoary," may refer to the sea foam; but if it is really intended to mean grey, its repeated use for the green sea is an additional proof of the correspondence of the sensations of the writer with those of the colour-blind.

I pass over the words *aithos*, *aithops*, &c., as Mr. Gladstone, while finding great difficulty in their interpretation, hardly considers them epithets of colour.

It may be useful to add a summary, appreciable at a glance, of the various objects to which colour epithets have been applied by Homer, classifying them as above described.

GROUP I.—*Objects conveying to the Colour-blind the Sensation of Yellow or Yellow Darkened.*

Ξανθός—	Human hair.
	Coats of horses.
Ἐρυθρός—	Copper.
	Wine, Nectar.
	Blood (arterial).

Φοίνιξ— Blood (arterial).
Coat of a horse.
The dragon or serpent.
The rainbow.
The jackal.
The lion.
Cloaks or mantles.
Red prows of ships.
The palm tree.

Ῥοδόεις— The rose.
Olive oil.

Κυάνεος— Bronze.
Dark eyebrows and hair.
A dark cloud.
The dark coat of a horse.
Masses of armed men.
Black mourning garments.
Sea sand.
The sea beating on rocks.
Red prows of ships.
The dragon or serpent.

Χλωρός— A pale face.
Fresh pulled twigs.
Honey.
Olive wood bark.
The nightingale.

Οἶνοψ— Red wine.
Oxen.
[The sea in circumstances of darkness.]

GROUP II.—*Objects conveying to the Colour-blind the Sensation of Blue, or Blue Darkened.*

Πορφύρεος—Various articles of clothing and furniture.
The rainbow.
Blood (venous).
A dark cloud.
Waves and the darkening sea.
Death.

Ἰοειδής— The violet.
The sea.
Iron.
Dark dyed wool.
[Dark living sheep].

EXTRA GROUP.—*Objects conveying to the Colour-blind a Neutral Sensation.*

Πολιός— Human hair in old age.
Iron.
The hide of a wolf.
The sea.

I think the following propositions may be now taken as made out on the evidence supplied by Mr. Gladstone:—

1. That Homer's applications of colour epithets are in many cases inconsistent with the normal ideas in regard to them. This is the first and most general symptom of colour-blindness.

2. That this inconsistency is particularly noticeable in the use of the expressions for red and green. This is a further and more definite symptom, showing the peculiarly defective sensations in regard to these particular colours.

3. But that when the objects referred to are classified in two groups, according to the two colour sensations they respectively offer to the colour-blind eye, the use of the colour-epithets becomes consistent, no epithet belonging to one group being used (except in one doubtful case) for an object belonging to the other. This is a still more definite symptom, pointing, as it seems to me, to the *dichromic* nature of the malady.

It is not my province to carry the matter further; but if the explanation offered be correct, it may involve some very interesting considerations.

One may ask whether the defect in vision which gave rise to these singular uses of the colour epithets was likely to have been general among the people of the time? Do the expressions convey what would have been the general sense of the Greeks of the Homeric age? If so, we may fully concur in Mr. Gladstone's hypothesis, that the organ of colour was but partially developed among them, while at the same time we learn exactly what was the nature of their deficiency. It would be a most interesting fact in physiology and optics if we could show, in this way, that dichromatism was an early stage of human vision, out of which the present more comprehensive and perfect faculty has been gradually developed in the course of some thousands of years.

But on the other hand, it is quite possible that this defect was not general, that it existed only in the person or the writer whose language exhibits it. If this view is correct it may have a most important bearing on a dispute that has long agitated the scholarly world, namely, as to the authorship of the Homeric Poems.

If we can trace, running through the whole of these immortal works, the distinct and consistent evidence of a well-marked personal peculiarity in the writer—a positive characteristic by which his individual identity may be, in all parts, clearly inferred—we have the strongest possible proof, by internal evidence, of the existence of a single author, to whom the whole of the poems are due.

WILLIAM POLE

NOTES

AMONG the well-deserved decorations awarded in connection with the Paris Exhibition is that of Grand Officer of the Legion of Honour to the eminent chemist M. Pasteur.

AT the annual meeting of the Mathematical Society, November 14, Lord Rayleigh, F.R.S., instead of giving an address, will read a paper on the Instability of Jets.

IN connection with the operations of the United States Fish Commission during the past summer, *Harper's Weekly* furnishes some particulars of what may be considered as one of the most important discoveries of recent date in regard to the geology of North America. During the operations of the Commission a formation was met with which belongs probably to the miocene or later tertiary, as shown by the occurrence of numerous fragments of eroded, hard, compact, calcareous sandstone and sandy limestone. These are usually perforated by the burrows of *Saxicava rugosa*, and contain in more or less abundance fossil shells and fragments of lignite, radiates, &c. These fragments have generally been hauled up by trawl lines from depths of from 50 to 250 fathoms, and have already furnished a large number of species, some of them northern forms still living on the New England coast, others for the most part extinct. A conspicuous fossil of an undescribed species belongs to the genus *Isocardia*. Other genera are *Mya*, *Ensatella*, *Cyprina*, *Natica*, *Cardium*, *Cyclocardia*, *Fusus*, *Latirus*, *Turritella*, &c. The specimens so far obtained range from George's Bank to Banquereau, a region of at least several hundred miles in length, and extending along the outer banks from off Newfoundland nearly to Cape Cod. Indeed, it is suggested by Prof. Verrill that the formation constitutes in large part the plateaus known as fishing banks, frequented by such large numbers of cod, halibut, &c. The credit of bringing these specimens to light is due chiefly to Mr. Warren Upham, who originally visited Gloucester for the purpose of investigating certain glacial drift and fossiliferous deposits, and who obtained many of the specimens from fishermen who had brought them in and kept them as curiosities.

IN the summer of 1877 an expedition in the interest of the Princeton (U.S.) College Museum of Geology and Archæology was fitted out for the purpose of making explorations in the tertiary beds around Fort Bridger and in Central Colorado, especially with a view of securing specimens of some of the interesting fossil vertebrates of which Prof. Cope and Prof. Marsh have described so many species. Six persons connected with Princeton College either as professors or students constituted the party, and the results of their labours were rich and varied beyond their expectation. The objects obtained since the return of the expedition have been subjected to a critical investigation by experts, and No. 1 of the report has just made its appearance in the form of a pamphlet of about 150 pages, with numerous illustrations. As might have been expected, the greater part of the collection consisted of species already collected and for the most part described. But in addition to these a considerable number of novelties rewarded the zeal of the explorers. These are described and many of them figured in the pamphlet referred to. Not the least valuable part of the report, *Harper's Weekly* states, consists of a systematic catalogue of the eocene vertebrates of Wyoming, as compiled from all accessible sources. Of the genera mentioned there are 70 belonging to the mammals, 3 to the birds, 27 to the reptiles and amphibians, and 17 to the fishes. Of species there are 114 of mammals, 7 of birds, 79 of reptiles and amphibians, and 51 of fishes, making a total of 251 species—certainly a very satisfactory showing for a portion of the extinct vertebrate fauna of the west.

As has been reported in the papers, M. Giffard's captive balloon has been sold to Mr. Gooch, of the Princess's Theatre, to be exhibited in London. The sale does not include the winding-up apparatus and machinery, which will remain in the Tuileries grounds, and be utilised for a second captive balloon, which will be built by M. Giffard, during the winter, for next season. The new captive balloon is to be enlarged and improved in details, so that its working capacities may be increased. The increased interest in ballooning has been manifested by the acceptance by the public authorities of the services of the École dès Aéronautes Français for executing scientific ascents at Versailles on the day of the great *fête*, and at Paris on the occasion of the inauguration of the Mansion-house of the 19th arrondissement. This École des Aéronautes was established three years ago by a number of persons who escaped from Paris in a balloon during the siege, for the purpose of promoting practice in aeronautics.

Nothing has occurred at the meeting of the Social Science Congress calling for special notice on our part. Lord Norton, the president, on the basis of doubtful statistics, seemed to think that the teaching of a "jumble of botany, physiology, &c.," in our elementary schools, is the cause of a supposed imperfection in the teaching of other branches in these schools. Certainly, if these subjects are jumbled they will do more harm than good, but as Lord Norton thinks our existing old universities are pretty near perfection, and are sufficient for the wants of the country, it may be doubted whether he has anything like an adequate knowledge of our educational needs. The Hon. G. C. Broderick seems to be pretty much of Lord Norton's opinion with regard to our universities, and virtually admitted that their highest purpose was to be "finishing schools for young gentlemen." On the question of increasing the number of our universities, there were various shades of opinion; all whose opinions are of any weight, however, agreed that increase is necessary, differing only as to the particular form which it should take.

The following statement with regard to Mr. Edison's recent invention appears in the *Times*:—It appears, from the New York papers, that a company has been started in New York called "The Edison Electric Light Company," with a capital of 300,000 dollars. The object of the company is stated generally to be "the production of heat, light, and power by electricity." The present object, however, is to supply a fund which is to assist Mr. Edison in carrying forward his experiments to a point where he shall give a positive demonstration of the powers of his new inventions. Precisely what these inventions are in all their details of transmission of force and the multiplication of the light derived from electricity, Mr. Edison has not yet told to anybody, fearing that the devices may be patented abroad. The invention, as to the use of electric lights, it is said, will not include the use of carbon points, as ordinarily known in electric lights, but instead the incandescence of a metal simpler and cheaper in every way. Mr. Edison has determined upon the general features of his light, its manner of production, &c.; but in many minor points connected with the distribution of the light for ordinary domestic and business purposes much work has yet to be done. It was at first supposed that 100,000 dollars would be a sufficient experimental fund, but the larger amount was finally determined upon.

The following is the title of the essay to which the Howard medal of the Statistical Society will be awarded in November, 1879; the essays to be sent in on or before June 30, 1879:—"On the Improvements that have taken place in the Education of Children and Young Persons during the Eighteenth and Nineteenth Centuries." The council have decided to grant the sum of 20*l*. to the writer who may gain the "Howard Medal" in November, 1879.

In his just published report on the trade, &c., of Kiel, her Majesty's Vice-Consul states that the existence of a large bed of pure salt in the neighbourhood of Segeburg, about thirty-five miles distant, is certain. The bed lies about 144 metres from the surface. Two shafts were sunk, one of which reached 116 metres and the other 85 metres, when underground water filled both up to within 28 metres of the surface. Powerful pumps have been erected, which have emptied the water down to 40 metres, and, although constant pumping shows only a slight decrease, the chief engineer has no doubt of eventual success. In five days the largest pump brought up about 50,000 cubic metres of water, representing a weight of 50,000,000 kilos. The water contains from sixteen to twenty per cent. of salt. The report further states that, in the neighbourhood of Elmshorn, the German authorities are boring for coal. They have reached about 4,000 feet from the surface, but at present have found only red clay, intermixed with particles of salt.

According to a Japan contemporary, an attempt, on a more extended scale than that of last year, has been made this season to introduce Japanese black teas into the European market. The samples sent in 1877 were favourably reported on, and it was hoped that an outlet had been found for the continually-increasing quantity of tea produced. These hopes, however, appear to be fading, and even if the existing prejudice against the article can be overcome, our contemporary finds it difficult to see how, with a yearly-increasing export from China and India, leaving Ceylon entirely out of the question, it can ever be made a paying speculation. Much is still hoped from the United States, but the verdict of the American trade upon it has yet to be received. From the same source we learn that the four Japanese gentlemen who were recently in Sydney have gone to Melbourne with the object of furthering an extension of trade with Australia, more especially in the direction of wool and sheep.

The publication is announced (Ch. Stahl's Verlag in Neu-Ulm) of a "Grosses illustrirtes Kräuterbuch," containing a complete description of all plants and herbs in reference to their uses, their effects and application, their culture, collection, and preservation. It contains instructions for the preparation of all kinds of medicines, juices, syrups, conserves, essences, powders, &c. The work contains coloured illustrations, and is published in fifteen parts.

On Saturday evening a most interesting *soirée* took place at the Continental Hotel, Paris. The former pupils of the Central School of Arts and Manufactures received the foreign engineers who had taken part in the Universal Exhibition. At supper M. Dumas was in the chair, and had on his right hand M. Teisserenc de Bort, and on his left Mr. Cunliffe Owen. The hotel was illuminated as usual on such occasions, with the Jablochkoff candles, and a display of electric machines took place. While speaking of the exhibition we may state that the society for delivering lectures to the visitors, to the foundation and progress of which we have several times referred, has been a great success. It has been most heartily patronised by M. Bardoux, the Minister of Public Instruction. The visits to the exhibition by the working men travelling with the funds of the great lottery have been taken advantage of by the lecturing organisation, to give numerous special lectures in connection with the various industries. Not less than forty-four lectures were delivered on Monday week to as many different assemblies selected for the purpose.

A silver medal has been awarded at the Paris Exhibition to Mr. Edward Whymper for the engravings which he contributed. This is the highest award made to any British engraver, and is we believe the only silver medal that has been given to any engraver on wood of any country.

A correspondent, Mr. Crowther, proposes that instead of using magneto-electric currents in the Bell telephone, induced electric currents be employed. This he proposes to accomplish by using adjacent flat spirals of copper wire, through one of which a current is sent and the other joined to the line wire and attached to a similar receiver at the distant end. We believe a somewhat similar suggestion has already been tried but with no practical benefit.

It is stated that in the Island of St. Vincent the cocoa-nut palm (*Cocos nucifera*) is now found very sparingly, though at one time the palm was one of the most profitable of all the plants grown in the island. About a quarter of a century ago the palms were visited by a severe blight, from which they have never recovered. It is calculated that about a million cocoa-nut trees are about the present time bearing fruit in the archipelago of Seychelles, and during the next five years quite half as many more will probably be producing fruit.

Highly interesting remains of Roman structures have recently been discovered on the Capersburg, near Friedberg, in the Grand Duchy of Hessen. The excavations are under the direction of Herr G. Dieffenbach, and are being made at the instigation of the Hessian Historical Society of Darmstadt.

The Leeds Philosophical and Literary Society send us an attractive programme of lectures, mostly scientific, for session 1878-9. We notice that on January 7 Prof. Thorpe is to lecture on the Solar Eclipse of 1878.

Signor A. Ponti, of Milan, has intimated to the Paris Academy that he intends to place at its disposal a sum of 60,000 lire for the foundation of an annual prize, to be distributed as the Academy thinks advisable.

In Class 15 of the Paris Exhibition, a gold medal was awarded to Messrs. Légé and Co., not Léqé, as misspelt in the "first proof" of the list referred to last week.

On September 23-26, 1879, the third meeting of the "International Congress of Americanists" will take place at Brussels, under the protectorate of the King of the Belgians and the presidency of the Count of Flanders.

We have received Part I. of "The Herefordshire Pomona," containing coloured figures and descriptions of the most esteemed kinds of apples and pears, edited by Robert Hogg, LL.D., F.L.S., and published under the auspices of the Woolhope Club (London: Hardwicke and Bogue). The work promises to be one of the most magnificent of its kind, and the coloured illustrations are the finest specimens of chromolithography we have seen; they are by Severeyns, of Brussels. The text, besides descriptions of the various kinds of apples and pears figured, contains a learned and interesting paper by Dr. Bull "On the Early History of the Apple and Pear," and by the same author, a "Life of Thomas Andrew Knight," the eminent horticulturist, of whom there is a fine portrait. This work is in the highest degree creditable to the Woolhope Club. From a prefixed notice we learn that "The Herefordshire Pomona" was originally intended to form a work of local character, as its title indicates, but the great and widespread interest with which the announcement of its publication has been received induces the Woolhope Club to believe that it will be more useful if its scope be made more general. It is intended, therefore, subject to the favour and support it may meet with, to make this Pomona a thoroughly English work. Its local name will still be retained, but it will embrace all apples and pears of established merit cultivated in Great Britain, even though some of the new, or special varieties, may not as yet be grown in Herefordshire. The Second Part of "The Herefordshire Pomona" will be published during the summer of 1879, and will contain, in continuation of the introductory matter, a paper "On Modern Apple Lore;" "A Sketch of the Life of Lord Scudamore," by Dr. Bull, with a full-page portrait; and a paper "On the Cordon System of Growing Pears," by Sir Henry E. C. Scudamore Stanhope, Bart., with a full-page woodcut of the Cordon Wall at Holme Lacy. These will be followed by six coloured plates of such different varieties of fruits as may be procured in perfection during the ensuing season. The Pomona Committee of the Woolhope Club will feel indebted for any assistance that may be rendered to them by supplying information with reference to any new or rare apples and pears of acknowledged merit; their origin, date of production, and description of the fruit. If it be desired to submit them to the judgment of the Committee, with a view to their publication in the work, it will be necessary to send a few well-grown typical specimens of the fruit, that such as are selected may be carefully drawn and coloured from nature, and their descriptions and merits verified. Parcels of fruit should be sent to "The Pomona Committee, Free Library, Hereford."

A new mineral spring has recently been discovered at Suhl, in Thuringia, which is particularly rich in chloride of calcium, according to the analysis of Professors Reichardt (Jena) and Sonnenschein (Berlin). Otherwise it resembles the Elizabeth spring of Kreuznach in its composition. The authorities of Suhl intend transforming their charmingly situated little Thuringian town into a fashionable watering-place.

The twenty-fifth volume of the excellent German scientific series, *Die Naturkräfte*, contains an able treatise on the conservation of energy as the basis of modern physics, by Dr. G. Krebs, of Frankfort-on-the-Main. After some introductory chapters on the changes occurring in nature, on forces, the conversion of finite motions and the meaning of the words work and energy, the author gives a condensed explanation of the sound-oscillations, the conversion of kinetic into caloric energy, and the mechanical equivalent of heat. He then treats of the inner constitution and the three aggregate states of matter, the propagation of heat and light, the identity of the last-named forces, and ends with a chapter on electricity and magnetism, and one on the dispersion of energy. The little book contains numerous woodcuts.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Capt. E. Waterhouse and Mr. Samuel Thomson; a Common Roe (*Capreolus caprea*) from Greece, presented by Mr. Edward Jones; a Common Jackal (*Canis aureus*) from India, presented by Capt. Easson; a Common Seal (*Phoca vitulina*), European, presented by Messrs. Thompson and Gough; a Bornean Fireback (*Euplocamus nobilis*) from Borneo, presented by Mr. A. Dent; two Mandarin Ducks (*Aix galericulata*) from China, presented by Mr. Edward Trelawny; a Common Marmoset (*Hapala jacchus*), a Tuberculated Lizard (*Iguana tuberculata*), a Teguexin Lizard (*Teius teguexin*), a Merrem's Snake (*Liophis merremi*), a Black-headed Snake (*Homalocranion melanocephalum*), a Plumbeous Snake (*Oxyrhopus plumbeus*), a d'Orbigny's Snake (*Heterdon d'orbignyi*), an Anaconda (*Eunectes murinus*) from South America, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

A NEW GALVANOMETER FOR STRONG CURRENTS

ON the following principle an ordinary tangent galvanometer can be transformed into an instrument suitable for the measurement of strong currents such as produced by powerful magneto- or dynamo-electric machines.

Suppose the circular coil of a tangent galvanometer mounted so as to turn round its horizontal diameter lying in the meridian, and assume the needle to be freely movable *in all directions*, then the effect which the current produces upon the magnet at different inclinations of the coil to the horizontal plane is as follows:—

1st. If the ring is in the vertical position (in the meridian) we have the ordinary form of tangent galvanometer, for which

$$\tan \alpha = \frac{k\,I}{H} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where α is the deflection of the needle in the horizontal plane, I the strength of the current, k a constant depending upon the dimensions of the coil, and H the horizontal component of the earth's magnetism.

2nd. If the ring is in the vertical position the magnet is only deflected in the plane of the meridian, and the deflection is determined by

$$\tan \beta = \frac{k\,I}{V} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where β is the deflection and V the vertical component of the earth's magnetism. This would be a tangent galvanometer in which the directive force of the current is opposed by the *vertical* component of the terrestrial magnetism.

By the combination of these two formulæ we obtain

$$\frac{\tan \alpha}{\tan \beta} = \frac{V}{H}.$$

Hence, the tangents of the two deflections are in inverse proportion respectively to the two components of the earth's magnetism.

Since $\frac{V}{H} = \tan i$, where i is the "magnetic dip," this relation may be used to ascertain the "dip" by a method similar to that of Prof. Wilhelm Weber by the inductive action of the earth.

3rd. If the ring is neither in the vertical nor in the horizontal position, but is inclined at any angle ϕ to the horizontal plane, the magnet is simultaneously deflected from the plane of the meridian through an angle α and from the horizontal plane through an angle β. In this case we have to introduce, instead of k in the equations 1 and 2 respectively, $k \sin \phi$ and $k \cos \phi$, whereby they become

$$\tan \alpha = \frac{k\,I}{H} . \sin \phi \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\tan \beta = \frac{k\,I}{V} . \cos \phi \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Combining these two equations we obtain the formula

$$\frac{\tan \alpha}{\tan \beta} \cot \phi = \frac{V}{H} = \tan i,$$

ϕ being known and α and β read off, the "dip" may be found by such measurements without *altering* the inclination of the coil.

If the ring is gradually brought from the vertical to the horizontal position, whilst a current I passes through it, the deflection α decreases proportionally from the maximum $\tan \alpha = \frac{k\,I}{H}$ to zero. At the same time the deflection β increases from zero to the maximum $\tan \beta = \frac{k\,I}{V}$.

For practical measurements we need only consider the deflection α in the horizontal plane, and for this reason the needle should work on a vertical axle pivoted at both ends.

With this form of instrument I was enabled to measure very strong currents.

It will be readily understood that a current which would throw the needle to nearly 90° when the ring is vertical, will, when it is suitably inclined, only deflect the needle to that part of the scale (45°) where readings are most accurate.

If the instrument and place of observation remain the same, we can substitute in equation (3) a new constant K for $\frac{k}{H}$ whereby it is simplified to

$$\tan \alpha = K I \sin \phi.$$

Further we have for other currents I_1, I_2, &c., at other angles of inclination ϕ_1, ϕ_2, &c.

$$\tan \alpha_1 = K I_1 \sin \phi_1,$$
$$\tan \alpha_2 = K I_2 \sin \phi_2, \text{ \&c.,}$$

hence,

$$\tan \alpha : \tan \alpha_1 : \tan \alpha_2 \ldots = I \sin \phi : I_1 \sin \phi_1 : I_2 \sin \phi_2, \text{ \&c.,}$$
$$\text{or } I : I_1 : I_2 \ldots = \frac{\tan \alpha}{\sin \phi} : \frac{\tan \alpha_1}{\sin \phi_1} : \frac{\tan \alpha_2}{\sin \phi_2} \ldots$$

By this relation different currents measured at different inclinations of the ring can be compared.

The following separate cases may serve as further illustrations:—

Case 1. Currents of different strength I_1, I_1, $I_2 \ldots$, sent through the coil at the same inclination ϕ, give—

$$\tan \alpha : \tan \alpha_1 : \tan \alpha_2 \ldots = I : I_1 : I_2 \ldots$$

Therefore the law of tangents holds also for the inclined ring.

Case 2. The same current I sent through the ring at different angles of inclination ϕ, ϕ_1, $\phi_2 \ldots$ gives

$$\tan \alpha : \tan \alpha_1 : \tan \alpha_2 \ldots = \sin \phi : \sin \phi_1 : \sin \phi_2 \ldots$$
$$\text{or } \frac{\tan \alpha}{\sin \phi} : \frac{\tan \alpha_1}{\sin \phi_1} : \frac{\tan \alpha_2}{\sin \phi_2} = \ldots = C$$

where C a constant.

The tangents of the deflections are therefore in the same proportion as the sines of the inclinations; or in other words, the tangents of the deflections divided by the sines of the corresponding inclinations give for the same strength of current a constant value.

Case 3. For different currents I, I_1, $I_2 \ldots$ sent through the ring at inclinations ϕ, ϕ_1, $\phi_2 \ldots$ giving the *same* deflection α (say of 45°) we have

$$I : I_1 : I_2 : \ldots = \frac{1}{\sin \phi} : \frac{1}{\sin \phi_1} : \frac{1}{\sin \phi_2} \ldots$$
$$= \operatorname{cosec} \phi : \operatorname{cosec} \phi_1 : \operatorname{cosec} \phi_2 \ldots$$

and the instrument thus used acts as a *cosecant* galvanometer.

The instrument which I used to ascertain the degree of accuracy of the method described consisted of a wooden ring of 30 cm. diameter, wound for some experiments with a few convolutions of wire, and for other experiments with a copper band. This ring, in the centre of which a small magnetic needle was placed, could be turned round its horizontal diameter, and its inclination read off on a graduated quadrant. To adjust the instrument the ring is approximately placed in the horizontal position; a current is then sent through the coil, and if the needle is deflected from the meridian, the inclination of the ring must be carefully altered until no deflection occurs. In this position the quadrant is fixed so that its zero point coincides with the index attached to the coil, and the instrument is now ready for use.

The following tables contain records of some of the experiments made with this instrument:—

Table I. gives the results obtained with a coil of seven convolutions of wire of ·074 Siemens' units resistance, and with a needle turning on a point. One Bunsen's cell was used, and the strength of current varied by the introduction of resistances. For each current-strength readings were taken at inclinations of the ring, the sines of which are proportional to the even integers 2 to 10.

TABLE I.

Resistance in circuit.	1 S.U.			2 S.U.			3 S.U.			4 S.U.			5 S.U.			6 S.U.			1 S.U.		
$\sin\phi$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$
1	59°·5	1·698	1·70	45°·9	1·032	1·03	35°·47	·7125	·712	28°·7	·5475	·547	23°·9	·4431	·443	20°·35	·3709	·371	61°·87	1·871	1·87
·8	56·2	1·494	1·87	39·5	·8243	1·03	29·7	·5704	·713	23·55	·4358	·545	19·42	·3526	·441	16·57	·2975	·372	56·32	1·500	1·87
·6	48·25	1·120	1·87	31·72	·6181	1·03	23·15	·4280	·713	18·0	·3249	·541	14·85	·2651	·442	12·4	·2199	·367	48·3	1·122	1·87
·4	36·67	·7446	1·86	22·17	·4061	1·01	15·85	·2839	·710	12·22	·2166	·541	10·0	·1763	·441	8·25	·1450	·362	36·87	·7450	1·86
·2	20·27	·3693	1·85	11·70	·2071	1·03	8·02	·1409	·704	6·05	·1060	·541	5·0	·0875	·437	4·17	·0729	·364	20·27	·3693	1·85

It will be seen from this table that the value of $\frac{\tan a}{\sin\phi}$ is as nearly a constant as can be expected from this kind of measurement.

Table II. gives the results obtained with the same coil and needle as before, but with the current unaltered in strength (one Bunsen's cell suitably reduced by the insertion of a small resistance). The order of experiments is shown by the arrows.

TABLE II.

	I.			II.			III.		
$\sin\phi$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$
·1	↓ 10°·4	·1835	1·83	10°·25	·1808	1·81	↓ 10°·25	·1808	1·81
·2	20·2	·3679	1·84	20·15	·3669	1·83	20·15	·3669	1·83
·3	29·1	·5566	1·85	29·05	·5554	1·85	29·00	·5543	1·85
·4	36·95	·7522	1·88	36·75	·7467	1·87	36·65	·7440	1·86
·5	42·95	·9309	1·86	42·85	·9276	1·85	42·95	·9309	1·86
·6	48·15	1·116	1·86	48·15	1·116	1·86	48·1	1·115	1·86
·7	52·45	1·301	1·86	52·5	1·303	1·86	52·45	1·301	1·86
·8	56·2	1·494	1·87	↑ 56·05	1·485	1·86	56·2	1·494	1·87
·9	59·1	1·671	1·86	59·1	1·671	1·86	59·1	1·671	1·86
1	61·9	1·873	1·87	61·8	1·865	1·86	61·7	1·857	1·86

The smaller value of the constant at the top of each column is doubtless due to slight mechanical inaccuracies in this *experimental* instrument.

Table III. gives the results obtained with the copper band provided with stout leading wires and with the needle fixed to an axle. The resistance of the copper band, including the leads, was only ·001 Siemens' units. Three Bunsen's cells connected parallel were used without additional resistance.

TABLE III.

$\sin\phi$	a	$\tan a$	$\frac{\tan a}{\sin\phi}$
1	66°·9	2·344	2·34
·8	61·6	1·849	2·31
·6	54·4	1·397	2·33
·5	49·4	1·167	2·33
·4	42·9	·9293	2·32
·2	25·1	·4684	2·34
·1	13·2	·2345	2·34
1	66·8	2·333	2·33

In this table the greatest difference from the mean of the constant (2·33) is not more than ·8 per cent.

The foregoing experiments having shown that the measurements with this instrument are, as to exactness, in no way inferior to those with the usual form of tangent galvanometer, I also employed it for the currents of dynamo-electric machines.

The first of these experiments was made with a Siemens' machine of smallest size. Besides the galvanometer an electric lamp was in circuit. The strength of the current and the intensity of the light was measured, and at the same time the number of revolutions of the armature counted. The results are given in the next table.

TABLE IV.

Revolutions of armature.	Deflection a ($\sin\phi = ·2$)	$\tan a$	$\frac{\tan a}{\sin\phi}$	Intensity of light in standard candles.
860	38°	·7813	3·906	3200
851	37	·7536	3·768	2750

The second experiment was made in the same way as the preceding, but with a Siemens' machine of medium size. The results are given in

TABLE V.

Revolutions of armature.	Deflection a ($\sin\phi = ·1$)	$\tan a$	$\frac{\tan a}{\sin\phi}$	Intensity of light in standard candles.
660	28°	·5317	5·317	4100
696	33·5	·6619	6·619	6400
692	33	·6494	6·494	7700[1]

The deflections in the experiments with the small machine were taken with the galvanometer ring at an inclination, the sine of which is equal to ·2; with the larger machine the sine of the angle of inclination was equal to ·1. The column headed $\frac{\tan a}{\sin\phi}$ gives in both cases the tangent of the deflection which would be obtained with the vertical ring.

By these two tables I intend merely to show that even such powerful currents which give a light of thousands of candles produce readable deflections with a suitable inclination of the ring.

I may add that the method I have just described to reduce the action of a coil upon the magnetic needle by turning it round a horizontal axis will scarcely be limited to the tangent galvanometer, but that this method very likely can be used with other galvanometric apparatus for many purposes where shunts are not desirable.

EUGEN OBACH

GULF-WEED[2]

FROM the time of Columbus to the present day the gulf-weed growing in the "Sargasso Sea" has attracted the attention and excited the interest of all voyagers who have crossed the

[1] With other carbon points than used before.

[2] Om de under Korvetten *Josephines* expedition, sistliden sommar (1869), insamlade Algerne. Af J. G. Agardh, Öfversigt af *Kongl. Vetenskaps-Akademiens Förhandlingar*, 1870. No. 4, Stockholm.

Enumeration of Algæ collected by Mr. Moseley, Naturalist to H.M.S. *Challenger*, at St. Thomas, Bermudas, Coast of Brazil, Cape de Verde Islands, St. Paul's Rocks, Fernando de Noronha, Tristan d'Acunha, Inaccessible Island, Simon's Bay, Seal Island, Marion Island, Heard Island, and Kerguelen's Island. By Prof. G. Dickie, M.D., F.L.S., Linnean Society's *Journal*—Botany, vol. xiv.

Atlantic. Almost every one who meets with the plant on his first trip across the ocean brings home a small bottle filled with the weed, which is shown to admiring friends, and then put away and forgotten. But the plant is much too interesting to be thus thrown aside without examination. Let the bottle be carefully broken so that the gulf-weed may be removed without injury; then place it in salt water—in sea-water if it can be got—in a large vessel of clear glass, where it will have room to expand, and then will be seen its beauty and grace of form, no small addition to which are the pretty and minute species of Campanularia, Plumularia, and Sertularia which twine around its branches, while other parts of the plant are covered by Polyzoa with a delicate lace-work as hard as stone.

But it is not only on account of its beauty that gulf-weed is deserving of attention; there is a history attached to it which renders it one of the most interesting vegetable productions of the sea. I propose, therefore, to give a summary of all that is yet known respecting the habits and history of this plant.

Whether the Sargasso Sea was known to the ancients is doubtful. Two descriptions, by ancient writers, of a kind of "Mar de Sargasso," near the coast of Africa, have been transmitted to us.

Humboldt ("Aspects of Nature," pp. 46, 47, Bohn's edition) has shown that both these descriptions refer to localities too near the coast of Africa to be applicable to the Sargasso Sea. The first description is from a work which Humboldt says for a long time bore incorrectly the name of Aristotle; it is as follows:—"Phœnician mariners came in a four days' voyage from Gades to a place where the sea was found covered with rushes and sea-weed. The sea-weed is uncovered at ebb, and overflowed at flood tide." There are no rushes mixed with the sea-weed in the Sargasso Sea, neither is the weed covered or uncovered by the water according to the state of the tide. The second description, from the Periplus, which has been ascribed to Scylax, of Caryanda, is thus quoted by Humboldt: "The sea beyond Cerne[1] ceases to be navigable in consequence of its great shallowness, its muddiness, and its sea-grass. The sea-grass lies a span thick, and it is pointed at its upper extremity, so that it pricks." Now the Sargasso bank is in deep water, which is not muddy, and no sea-grass (which inhabits shallow water) ever grows on it. The Sargasso bank is much more than a span in thickness, and the upper extremity of the plant is not sharp enough to prick.

Columbus and his followers called the floating sea-weed "sargazo," a term which botanists have modified into SARGASSUM, as the generic name, adding, as the specific name, *bacciferum*, alluding to the great number of berry-like air-vesicles which assist to buoy up the plant when in the water. This alga is also sometimes called "*Fucus natans*," on account of its being found floating on the sea, and not attached to the shore or to rocks, while to sailors it is known by the name of "gulf-weed," and that part of the sea where it is met with in greatest abundance is called the Sargasso Sea.

The Sargasso Sea is situated in the North Atlantic, between 22° and 36° N. latitude, in the comparatively quiet space which is bounded on the south by the great Equatorial current, on the west and north by the Gulf Stream, and on the east by the Guinea current, which flows southwards. Humboldt[2] states that there are two principal banks, the larger of which lies a little to the west of Fayal, one of the Azores; the smaller near to the Bahamas. The situation, however, of the weed-banks varies in different seasons, according to the prevalent winds. Maury states[3] that "an area equal in extent to the Mississippi Valley, is so thickly matted over with gulf-weed, that the speed of vessels passing through it is often much retarded. When the companions of Columbus saw it, they thought it marked the limits of navigation, and became alarmed. To the eye, at a little distance, it seems substantial enough to walk upon. Patches of the weed are generally to be seen floating along the outer edge of the Gulf Stream. The sea-weed always 'tails' to a steady or constant wind, so that it serves the mariner as a sort of marine anemometer, telling him whether the wind, as he finds it, has been blowing for some time, or whether it has just shifted, and which way. Columbus first found this weedy sea on his voyage of discovery; there it has remained to this day, moving up and down, and changing its position, like the calms of Cancer, according to the seasons, the storms, and the winds. Exact observation as to its limits and their range, extending back for fifty years, assure us that its mean position has not been altered since that time." Dr. Harvey says[1] that he had made the voyage across the Atlantic four times, and only once found gulf-weed in any quantity. It then occurred in ridges of great length from ten to twenty yards in breadth. These ridges are separated by water, which flows between them like rivers or lakes.[2]

[1] "The Phœnician station for merchant vessels (Gaulea); or, according to Gosselin, the small estuary of Fedallah, on the north-west coast of Mauritiania." Humboldt, *Ib.*

[2] See "Views of Nature," Bohn's translation, p. 48.

[3] "Physical Geography of the Sea," p. 28, tenth edition.

One fact respecting the gulf-weed, hitherto unnoticed by botanists, has not escaped the keen eye of the sailor, namely, that the plants rise a few inches *above* the water, the upper branches not being immersed; hence it is readily observed from a distance. It is this power of supporting the upper branches out of the water in an erect position—a very unusual power in sea-weeds—that enables the gulf-weed to "tail" to the wind, as before mentioned.

Another peculiarity attending the floating weed is that no other marine plant has ever been found growing on it or with it; small zoophytes and polyzoa are, however, often attached to it. Although its vegetation is limited to one species, the Sargasso Sea is a great resort of animal life, and it lies within the northern limits of the wanderings of the Sperm whale. The Right whale sometimes crosses its northern boundary, where the water is cooler.

A third peculiarity affecting the *floating* gulf-weed is that it has neither root nor fruit; never in the Atlantic, or in other localities where it is met with, has it ever been found in fruit.[3] On this point I shall have more to say hereafter.

The genus Sargassum is the most highly organised of the Melanospermeæ, or olive-coloured sea-weeds. It possesses root, stem, branches, leaves, air-vesicles, and distinct organs of fructification. The species are very numerous. Agardh, in his "Species, Genera et Ordines Algarum," part 1, published in 1848, describes 126 species, which number has since been greatly increased. These species are classified into three sections and twelve tribes. Gulf-weed belongs to the highest section, namely, *Eu-sargassum*, or Sargassum proper, and to the twelfth tribe Cymosæ.

The genus Sargassum inhabits the tropical and sub-tropical seas of both hemispheres, extending on each side of the equator to about the 45° parallel of latitude, gradually increasing in number of species towards the line. With the exception of *S. bacciferum* (gulf-weed) and *S. vulgare*, which is also sometimes called "*Fucus natans*,"[4] the species are very local. Thus some grow on the coasts of Australia only, and the species of North Australia differ from those of the south. A remarkable group of Sargasso inhabits the coasts of Japan, where the plants grow in the warm waters of "the Black Current," the Pacific analogue of the Gulf-Stream of the Atlantic; other species are found in the China Seas, many in the Indian Ocean, and these are generally distinct from those of the Red Sea. The section *Cymosæ*, to which Gulf-weed belongs, inhabit chiefly the Atlantic and Indian Oceans and the Australian coasts.

With these extremely local habits, and permanently distinct species, it seems difficult to reconcile the errant habits and the fixed forms of *S. vulgare*, and the plant which has given its name to the Sargasso Sea; both species are found in most of the warmer seas in both hemispheres.[5] Slight deviations sometimes occur in these plants, but they are clearly traceable to local causes. Thus, in the Sargasso Sea, the plants have often shorter leaves, the branches are contracted, and the bristles of the air-vessels broken off; whereas, specimens from Sydney, New South Wales, have longer leaves, the air-vessels have very long bristles, which frequently form narrow leaves, and the habit of the plants is more lax and straggling.

S. vulgare produces fruit in all the localities where it is found; but, with regard to *S. bacciferum*, it has already been

[1] "Manual of British Algæ." Introduction, p. xxi., xxii., second edition.

[2] Besides the Sargasso-bank, in the Atlantic, Maury mentions several other accumulations of sea-weed known to mariners as "Sargassos." The immense banks of weeds in the South Pacific, through which ships pass in going to the Australian colonies, consist principally of a pelagic form of Macrocystis; of the composition of the other weed-banks little is known.

[3] "Om de under Korvetten *Josephines* „expedition, sistliden sommar (1869) insamlade Algerne." Af J. G. Agardh, Öfversigt af *Kongl. Vetenskaps-Akademiens Förhandlingar*, 1870, No. 4, Stockholm.

[4] It is much to be regretted that this term "*Fucus natans*" should not have been limited by authors to *S. bacciforum*.

[5] *S. bacciferum* is found in the Atlantic, between 22° and 58°, being sometimes carried on the Gulf Stream as far as the Orkney Islands. It is also found on the coasts of Spain and Portugal, and in the Mediterranean Sea, its presence in these localities also being due to the Gulf Stream. It is likewise met with in the Indian Ocean, the Pacific, on the coasts of Australia, and New Zealand.

observed that the specimens found *floating* in all the seas are always barren. The question then arises, how is the floating weed propagated? To this question Dr. Harvey[1] replies:—"It seems to me that the old frond, which is exceedingly brittle, is broken by accident, and the branches, continuing to live, push out young shoots from all sides. Many minute pieces that I have examined were as vigorous as those of a large size; but they were certainly not seedlings, and appeared to me to be broken branches, all having a piece of the old frond from which the young shoots spring. As the plant increases in size it takes something of a globular form, from the branches issuing in all directions, as from a centre."[2] The specimens brought to this country are merely the uppermost branches, the whole plant often attaining a diameter of three or four feet. The upper branches are of a light olive colour, the lower more or less brown; the lowest parts of all wither and decay, and finally drop away.

With regard to the origin of the plant there has been much controversy among algologists. On this point Harvey observes:—[3] "Nothing has yet been discovered; for, though species of Sargassum abound along the shores of tropical countries, none exactly corresponds with *S. bacciferum*. That the ancestors of the present banks have migrated from some fixed station is probable, but further than probability we can say nothing." Prof. Agardh, however, thought he had found the parent stock in a plant which grows on the banks of Newfoundland; and in his "Species, Genera, et Ordines Algarum," vol. i., published in 1848—a year before the second edition of Harvey's "Manual" appeared—thus writes of it:—"Natans semper sterilis, nec in pratis Atlanticis fructigera, Fructiferam et affixam e mari Americanum alluente habeo." In his before-mentioned notes on the algæ collected by the *Josephine* expedition, after referring to the passage just quoted, he says:—"I have received from the banks in the neighbourhood of Newfoundland specimens with root and fruit, which, although somewhat different in form, I nevertheless did not scruple to consider as belonging to the same species" (*S. bacciferum*); and he adds that "from no facts yet come to my knowledge have I had reason to change the opinion I had expressed in 1840 at the meeting of naturalists at Copenhagen, that the floating form originates from the Banks of Newfoundland, and perhaps grows on similar localities on the east coast of America, when it is provided with root and fruit." Since the publication of these observations, additional information relative to the fruit of *S. bacciferum* has been obtained. Specimens "covered with fructification" have been found by Mr. Moseley,[4] the naturalist of the *Challenger* expedition, in Harrington Sound, Bermudas, which islands lie in the very heart of the Sargasso Sea.

The fact, therefore, that *S. bacciferum* bears fruit *when attached to the land* in the Sargasso Sea and the Gulf Stream, may be considered as established.

With regard to the comparative antiquity of the Bermudas and Newfoundland plants, it must be observed that they both occur within the influence of the Gulf Stream. It is not likely that the Sargassum could make its way from the northern locality *against* the current of the stream; hence it seems most probable that it vegetated first at Bermudas, and thence emigrated, with the stream, northwards.

Other facts in connection with the two islands favour this view. Sir Wyville Thomson says[5]:—"Bermudas is practically an 'atoll,' or annular coral reef. . . . . What the basis on which the Bermudas reef rests may be, we have no means of telling; in fact, its having the form of an atoll precludes the possibility of our doing so. There seems to be little doubt, from Darwin's beautiful generalisation, which has been fully indorsed by Dana and other competent observers, that the atoll form is due to the entire disappearance by subsidence of the island round which the reef was originally formed. The abruptness and isolation of this peak, which runs up to a solitary cone about equal to that of Mont Blanc, is certainly unusual; probably the most reasonable hypothesis may be that the kernel is a volcanic mountain comparable in character with Pico in the Azores or the Peak of Teneriffe." It has been also stated[1] that "in the process of excavations carried out in order to accommodate the great floating dock, a bed of peat, with stumps of cedar trees in a vertical position, was found at a depth of forty-five feet below low-water mark, covered by beds of rock. Most conclusive proof is thus afforded that the Bermudas have changed their level, and sunk since they have been covered with a similar vegetation to their present one." These statements afford considerable evidence of the antiquity of the Bermudas. Now as to the comparative age of the Newfoundland Banks. Lieut. Payer[2] has observed respecting them:—"It is an established fact that ice-bergs and ice-fields laden with the *débris* and rubbish of Arctic lands, deposit these burdens round the outer edge of the Frozen Ocean, and to this process, partially at least, the origin of the Newfoundland banks is to be ascribed." It would seem from these observations that these banks have been formed since the glacial period, hence that they are more recent than the Bermudas. On the above grounds, therefore, it is but reasonable to conclude that the Bermudas plant has superior claims to that of the Newfoundland banks to be considered as the parent-stock of the Atlantic plant.

That the parent-stock originated in the Atlantic, and then found its way into the Indian and Pacific Oceans is, at least, doubtful, especially as a form of the plant called var. Capillifolium,[3] bearing fruit abundantly, has been found at Mauritius by Col. Pike. Thus, then, in two oceans out of the three, *S. bacciferum* has been obtained in fruit, but with sufficient differences in the forms to constitute varieties; whether the Bermudas plant differs from the others I have not been able to ascertain.

Prof. Mertens (see his work on the algæ collected by the Prussian expedition to Eastern Asia) supposed that *Sarg. dentifolium*, of the Red Sea, was the parent-stock of the floating Sargassum, on the ground that the same species of polyzoa were found on both plants. Not a very strong argument, especially as a remarkable difference exists in the structure of the two plants. *S. dentifolium* has a serrated midrib, while that of *S. bacciferum* is plain. This difference was observed by Prof. Agardh, who, in addition, expressed his belief[4] that *S. dentifolium*, an inhabitant of a tropical sea, could not make, or survive, the voyage round the Cape of Good Hope. It must then have had other means of making the voyage, as the plant has actually been found at Key West, Florida, by Dr. E. Palmer. Dr. Farlow,[5] who mentions this fact, observes: "It is not stated whether it was floating or attached. Dr. Palmer's specimens are more luxurious than those of the Red Sea, but the serrated midrib seems sufficiently characteristic to warrant us in supposing that the species is the same." Here then we have another instance of a tropical plant being found in both hemispheres. How did it get there?

According to the present conformation of the land in tropical and sub-tropical seas, there is no water-passage open in those latitudes between the Atlantic and Pacific, or between the Atlantic and Indian Oceans. In the north and also in the south, round "the Horn," the extreme cold would be fatal to all the species of Sargassum; and although certain species of this genus grow at the Cape of Good Hope, *S. bacciferum* has never yet been brought home from thence.[6] The presence of the plant in the warmer parts of the three great oceans where means of communication are now impossible, except between the Indian and Pacific Oceans, owing to the conformation of the land and climatal obstructions, remains still to be accounted for. This can only be done by referring to a time when Mexico was submerged, and the isthmus not yet in existence, and there was thus communication between the tropical Atlantic and Pacific; when open passages also existed between the Indian Ocean and the warmer parts of the Atlantic, and between the Indian and Pacific Oceans. Tropical and sub-tropical algæ would thus be free to pass from sea to sea. That these plants did so is the opinion of botanists and other scientific persons. In support of this opinion may be mentioned the occurrence of a considerable

1 "Manual of British Marine Algæ," second edition.

2 The floating gulf-weed is not the only plant which can maintain life in vigour, and propagate itself without producing fruit. *Gigartina Teedii*, and *Griffithsia secundiflora*, have vegetated many years on rocks in the vicinity of Plymouth, without producing fruit. They are both natives of the Mediterranean, where they yield fruit freely.

3 "Manual," *l. c.*

4 See extract from Mr. Moseley's letters communicated by Dr. Hooker, Linnean Society's *Journal*, vol. xiv. It is much to be regretted that Mr. Moseley has sent home no specimens of the Bermudas plant.

5 "Letters from the *Challenger*" in *Good Words* for February, 1876, pp. 98-100.

1 *Athenæum* for December 1, 1877. Review of voyage of the *Challenger*.

2 "New Lands Within the Arctic Circle," vol. i. pp. 41, 42.

3 I am indebted to Prof. Agardh for a fragment of a specimen of *S. bacciferum* from the banks of Newfoundland, and to Dr. Oliver, of Kew, for a fruitful specimen of Col. Pike's plant.

4 Agardh, *l. c.*

5 "List of Marine Algæ of the United States, with Notes of New and imperfectly-known Species." By G. W. Farlow. From *Proceedings* of the American Academy of Arts and Sciences, presented March 9, 1875.

6 Agardh, *l. c.*

number of sea-fishes inhabiting both sides of the Isthmus, which Dr. Günther has shown to be absolutely identical. To these may be added several species of mollusca. With reference to the mollusca Mr. Wallace[1] observes, "The long-continued separation of North and South America by one or more arms of the sea . . . is further rendered necessary by the molluscan fauna of the Pacific shores of tropical America, which is much more closely allied to that of the Caribbean sea, and even of West Africa, than to that of the Pacific Islands. The families of many of the genera are the same, and a certain proportion of very closely allied or identical species, shows that the union of the two oceans continued late into tertiary times. If fishes and mollusca could thus pass from ocean to ocean, there is no doubt that algæ could also pass. Besides *Sarg. bacciferum*, *S. vulgare*, and *S. dentifolium*, the following species, among others, are common to both hemispheres, namely, *Chnoospora fastigiata*, *Hydroclathrus cancellatus*, *Digenia simplex*, *Acanthophora Thierri*, and others too numerous to mention. It is further thought that such plants are among the oldest forms of algæ, and that algæ are among the oldest productions of the vegetable world. Geologists are of opinion that the tropical passage between the Atlantic and Pacific was open during the tertiary and cretaceous epochs. How long a time has elapsed since this period is another question that remains to be answered. This can only be done approximately. "From the Devonian period, or earlier," says Prof. Huxley,[2] "to the present day, the four great oceans, Atlantic, Pacific, Indian, and Antarctic, may have occupied their present positions, and only the coasts and channels of communication have undergone an incessant alteration." Mr. Croll, who, in his most interesting work "Climate and Time," brings astronomical science to bear upon the elucidation of geological problems, states that "the great ocean basins are probably of immense antiquity; that the great depressions of the Atlantic, Pacific, and Indian Oceans may be as old as the Laurentian period for any thing which geology shows to the contrary." He also remarks—"all our main continents and islands not only existed during the glacial period as they do now; the very contour of the surface was much the same as at the present day."[3] The migration of *S. bacciferum* from one ocean to the other must then have taken place previously to the commencement of the glacial period—the most recent glacial period, I mean—for Mr. Croll thinks that there were other glacial periods with intermediate warm periods during the tertiary epoch. He gives astronomical reasons[4] for saying that the commencement of the most recent glacial epoch cannot date back more than 240,000 years. As, then, there has been no material alteration of the surface of the land since that period, and our plant now inhabits and can live in the warmer parts only of the three great oceans, the barriers to their intercommunication being now closed as before-mentioned, it follows that this alga must be at least of greater antiquity than the glacial period, 240,000 years ago. How many thousands or hundreds of thousands additional years may be added to its age, it is impossible to say. Perhaps on some slab of rock from the depths of the earth the astonished and admiring botanist may yet recognise a fossil plant of the wandering Sargassum.[5]

If the presence of a great number of species in a limited area is suggestive that the parent-stock may have originated in that locality, then it is probable that the primary habitat of the genus Sargassum may have been in the Indian and adjacent oceans, since it is on the southern coasts of Asia, the islands in the Indian Ocean, and round the coasts of Australia and New Zealand (Mr. Wallace's "Oriental and Australian Regions," also his "Ethiopian Regions," Nos. 1 and 4), that the greater number of species of Sargassum are found. No less than forty species are known to inhabit the seas around Australia and New Zealand.

There are fair grounds for the opinion that many of the tropical algæ of the three great oceans are probably among the oldest forms of this class of plants—*S. bacciferum* and its congener *S. vulgare*, also *S. dentifolium*, and other algæ before mentioned may, therefore, be "survivals," still existing in health and vigour, of the marine vegetation of a very remote period, as ancient, at least, as the miocene[6] epoch, when the appearance and configuration of the country was, in all probability, different from what it is at the present day.

One cannot but look with wonder and admiration mixed with somewhat of veneration, on the wandering Sargussum, still in vigorous existence, which has survived so many changes of climate affecting different parts of the earth's surface; so much variation in the boundaries of the sea-shores; before which the rise and fall of empires, and the very existence of man, form almost inappreciable items in its life-history.

In order to show the great numerical increase in the species of Sargassum in the warmer seas, I shall conclude this article with a tabular view of their geographical distribution. In the division of regions I have followed Mr. Wallace. It is to be observed that as some species range through more than one region, they are consequently entered in each region, and thus the aggregate of species appears to be greater than it really is.

	1. Palæarctic.				2. Ethiopian.				3. Oriental.				4. Australian.				5. Neotropical.				6. Nearctic.			
	North Europe.	Mediterranean.	Siberia.	Manchuria or Japan.	East Africa.	West Africa.	South Africa.	Madagascar.	Hindostan.	Ceylon.	Indo-China.	Malayan.	Austro-Malayan.	Australia.	Polynesia.	New Zealand.	Chili.	Brazil.	Mexico.	Antilles or West Indies.	California.	Rocky Mountains.	East United States.	Canada.
Number of regions.	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Number of species.	-	6	-	13	11	2	7	9	22	4	16	20	1	36	13	8	2	6	1	10	-	-	1	-

MARY P. MERRIFIELD

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Master of Trinity College, Cambridge, has forwarded to the Vice-Chancellor certain statutes made by the College affecting the University, and in doing so intimates that the Colleges consider that the provisions of the Universities of Oxford and Cambridge Act, 1877, do not bind them to postpone their final adoption until one month after they have been communicated to the Council of the Senate. The statutes have reference to, among others, the Trinity Professorship of Physiology. They provide that any person hereafter elected to the Professorship shall be entitled to a Fellowship at Trinity unless he is Master or Fellow of some other College. The Trinity Professor of Physiology is to receive an annual stipend of 500*l*., in addition to the emoluments of a Fellowship. The new statutes also provide that there shall be paid by the College to the University an annual sum calculated upon the amount of the distributable income of the College, which is particularly defined. Such annual sums to commence from the time the statutes come into operation, and shall be in the first instance equal to 5 per cent. of the distributable income, to be increased to 7½ per cent. when the statutes have been ten years in operation, and to 10 per cent. when they have been fifteen years in operation. The provisions of these statutes with respect to the Trinity Professorship of Physiology shall take effect from and after the appointment of the first Trinity Professor of Physiology, under the provisions of a statute or statutes to be made with the consent of the College for the establishment of the said professorship.

THE French Government proposes to do an act of justice in raising the stipends of professors in science and medicine to the same amount as in the case of law and letters, 15,000 francs. Dr. Simplice, who writes on the subject in the *Union Médicale*, points out how unequally professors of pure science, as botany and chemistry, are rewarded as compared with, say, clinical professors, who can add enormously to their income by private

[1] "Geographical Distribution of Animals," vol. ii., p. 58.

[2] Address to the Geological Society, reported in the *Journal* of the Geological Society, May, 1870.

[3] "Climate and Time," p. 9.

[4] *l.c.*, p. 355.

[5] Among the fossil algæ known to botanists are some specimens of Sargassum.

[6] Mr. J. S. Gardner, F.G.S., has recently expressed his opinion that the American continents became united during the eocene period (see NATURE, vol. xviii. p. 192). If this be the fact, a great addition must be made to the antiquity of these plants.

practice. Dr. Simplice proposes that a maximum salary should be given to the former, and a minimum to the latter. This is a subject that calls for consideration here as well as in France.

SOCIETIES AND ACADEMIES

Boston, U.S.A.

American Academy of Arts and Sciences, October 9.—Charles Francis Adams, president, in the chair.—Prof. W. A. Rogers read a paper on the limits of accuracy in measurements with the microscope, in which he stated that Prof. E. N. Morley and himself independently measured 195 spaces having a magnitude of about $\frac{1}{500}$ of an inch, each space, however, varying slightly from this value. The measures were made with a glass eye-piece micrometer, a Beck's spider line micrometer, and with a screw attached to the sub-stage of the microscope. After the results were prepared for the press they were for the first time compared. It was found that the average difference between the results for a single space was 32 millionths of an inch, and the greatest difference was 12 millionths. There were only four cases in which the difference amounted to one hundred thousandth of an inch.—In a second paper Prof. Rogers gave a determination of the errors of the sub-divisions of a copy of the British yard known as Bronze No. 11 and of the metre of the U.S. Bureau of Weights and Measures and the production therefrom of an inch, which is one thirty-sixth of this particular yard, and of a centimetre, which is one-hundredth part of this particular metre, the temperature in both cases being 67° F.—Prof. John Trowbridge described a new electro-dynamometer for measuring strong electric currents without shunting them. The principle consists in cooling the two points in the revolving axis of the instrument where the current enters and leaves by means of a current of water and in using mercury pivots. The instrument can measure from a fraction of a Weber up to six hundred Webers. It is especially adapted for the measurement of currents produced by dynamo-electric machines.

Göttingen

Royal Academy of Sciences, July 6.—The following papers were read:—On the solution of equations of the fifth degree, by L. Kiepert.—On *Duboisia myoporoides*, by W. Marmé.—Herr Hänselmann of Brunswick presented to the Academy the certified copies of eighty-two letters written by or addressed to Gauss.

August 3.—On the feldspar in the basalt of the Hohe Hagne, near Göttingen, and its relation to the feldspar from the Monte Gibele on the Island of Pantellaria.

Paris

Academy of Sciences, October 22.—M. Daubree in the chair.—The President announced the deaths of M. Bienaymé, free Academician, and M. Leymerie, correspondent in mineralogy.—M. Des Cloizeaux read a note on the works of the late M. Delafosse.—The following papers were read:—On the thermal formation of the combinations of oxide of carbon with other elements, by M. Berthelot. The heats liberated by chlorinised and sulphurised combinations of carbonic oxide are less than those of hydrogen: which corresponds to their less stability.—Various thermal determinations, by M. Berthelot. This relates to boric acid, chromate of soda, biacetate of soda, iodide of silicium, and earthy phosphates.—On the vision of colours, and especially on the influence exercised on vision of coloured objects in circular motion when observed comparatively with similar bodies in repose; extract from a small work by M. Chevreul. He supports the view of dyers and artists that there are three simple colours, viz., red, yellow, and blue. He finds, also, that by a motion having a maximum of 160 to 120 turns, and a minimum of sixty per minute, one may generate the complementary of every colour submitted to this movement.—On ytterbine, a new earth contained in gadolinite, by M. Marignac. The name is given to recall its presence in the mineral of Ytterby, also its similarity to yttria, on one hand, by absence of colour, and to erbine, on the other, by the elevation of its equivalent (say 131); to both, by the *ensemble* of its properties. The atomic weight deduced for ytterbium would be 115 or 172·5, according as its oxide receives the formula YbO or Yb_2O_3.—On the dentition of Smilodons, by M. Gervais.—The disease of chestnuts in the Cevennes, by M. Planchon. The gradual death of the stem and branches is caused by an alteration of the roots, which become softened with a sort of moist gangrene, giving out an exudati n of tannic nature. These phenomena are caused by the mycelium of a fungus. M. Planchon thinks untimely irrigations are the chief *occasional* cause of the evil.—Processes for determining the butter in milk; reply to note by M. Adam, by M. Marchand.—Complementary observations on formulæ relating to perforation of iron armour plates, by M. Martin de Brettes.—M. Ponti, of Milan, announced his intention to place 60,000 Italian pounds at the disposal of the Academy, for founding an annual prize.—Observations on a communication from M. Amigues on flattening of the planet Mars, by M. Hennedy. He confirms M. Amigues' calculations from independent researches.—Remarks on M. Levy's note regarding a universal law relative to dilatation of bodies, by M. Boltzmann. He finds in fluid water a contradiction of M. Levy's theorem (about the pressure of an inclosed heated body increasing rigorously with the temperature).—Note relative to the theorem on the composition of accelerations of any order, by M. Lignine.—On the rectification of the ovals of Descartes, by M. Darboux.—Second note on the resolution in whole numbers of the equation (1) $ax^4 + by^4 = cz^2$, by M. Desboves.—On the Mosandrum of Prof. L. Smith, by M. Delafontaine. He rejects Prof. Smith's claim of priority, and affirms the identity of mosandric acid and terbine.—Researches on sulphates, by M. Etard. This relates to rose ferroso-ferric sulphates, mixed proto-sulphates, and simple or double sulphates, more or less hydrated.—On the nerve terminations in striated muscle, by M. Tschiriew. He has found, in several species, new forms of nerve-termination, intermediate between the motor termination (as met with in the frog), and the terminal plates. The most simple is in the tortoise; nerve-fibres deprived of myeline, ramify without anastomosing, and terminate, on the muscular bundles, by rods, sometimes smooth, but oftener moniliform, or surrounded by grains. There are generally several such terminations on one muscular fibre.—On the albuminoid matters of organs and of the spleen in particular, by M. Picard. Globuline exists in the spleen independently of the presence of blood.—On the hydrophorous reservoirs of Dypsacus, by M. Barthelemy. He rejects M. Boyer's view that the water present is produced by secretion (principally) and by dew, and attributes the liquid entirely to rain.—Apparatus for experimenting on the action of electricity on living plants, by M. Celi. This consists of a bell-jar, into which electricity is admitted by a metallic collector, connected with an insulated metallic vessel at 2 m. height, from which streams a thin vein of water.—Influence of salicylic and thymic acid, and some essences on germination, by M. Haeckel. While phenic acid suspends germination, salicylic acid (even in very small quantity) stops it altogether.

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