THURSDAY, MAY 18, 1882

## CHARLES DARWIN

### I.

THE object of this notice is to give a brief account of the life, and a proportionately still more brief account of the work, of Mr. Darwin. But while we recognise in him perhaps the greatest genius and the most fertile thinker, certainly the most important generaliser and one of the few most successful observers in the whole history of biological science, we feel that no less great, or even greater than the wonderful intellect was the character of the man. Therefore it is in his case particularly and pre-eminently true that the first duty of biographers will be to render some idea, not of what he did, but of what he was. And this, unfortunately, is just the point where all his biographers must necessarily fail. For while to those favoured few who were on terms of intimate friendship with him, any language by which it is sought to portray his character must seem inadequate, to every one else the same language must appear the result of enthusiastic admiration, finding vent in extravagant panegyric. Whatever is great and whatever is beautiful in human nature found in him so luxuriant a development, that no place or chance was left for any other growth, and in the result we beheld a magnificence which, unless actually realised, we should scarcely have been able to imagine. Any attempt, therefore, to describe such a character must be much like an attempt to describe a splendid piece of natural scenery or a marvellous work of art; the thing must itself have been seen, if any description of it is to be understood.

But without attempting to describe Mr. Darwin's character, if we were asked to indicate the features which stood out with most marked prominence, we should first mention those which, from being conspicuous in his writings, are already more or less known to all the world. Thus, the absorbing desire to seek out truth for truth's sake, combined with a characteristic disregard of self, led not only to the caution, patience, and candour of his own work—which are proverbial—and to the generous satisfaction which he felt on finding any of his thoughts or results independently attained by the work of others; but also to a keen and vivid freshness of interest in every detail of a new research, such as we have sometimes seen approached by much younger men when the research happens to have been their own. And indeed what we may call this fervid youthfulness of feeling extended through all Mr. Darwin's mind, giving, in combination with his immense knowledge and massive sagacity, an indescribable charm to his manner and conversation. Animated and fond of humour, his wit was of a singularly fascinating kind, not only because it was always brilliant and amusing, but still more because it was always hearty and good-natured. Indeed, he was so exquisitely refined in his own feelings, and so almost painfully sensitive to any display of questionable taste in others, that he could not help showing in his humour, as in the warp and woof of his whole nature, that in him the man of science and the philosopher were subordinate to the gentleman. His courteous consideration of others, also, which went far beyond anything that the ordinary usages of society require, was similarly prompted by his mere spontaneous instincts of benevolence.

> For who can always act? but he
> To whom a thousand memories call;
> Not being less but more than all
> The gentleness he seem'd to be,
>
> Best seem'd the thing he was, and join'd
> Each office of the social hour
> To noble manners, as the flower
> And native growth of noble mind;
>
> Nor ever narrowness or spite,
> Or villain fancy sweeping by,
> Drew in the expression of an eye,
> Where God and Nature met in light.

And this leads us to speak of his kindness, which, whether we look to its depth or to its width, must certainly be regarded as perhaps the most remarkable feature of his remarkable disposition. The genuine delight that he took in helping every one in their work—often at the cost of much personal trouble to himself—in throwing out numberless suggestions for others to profit by, and in kindling the enthusiasm of the humblest tyro in science; this was the outcome of a great and generous heart, quite as much as it was due to a desire for the advancement of science. Nothing seemed to give him a keener joy than being able to write to any of his friends a warm and glowing congratulation upon their gaining some success; and the exuberance of his feelings on such occasions generally led him to conceive a much higher estimate of the importance of the results attained than he would have held had the success been achieved by himself. For the modesty with which he regarded his own work was no less remarkable than his readiness enthusiastically to admire the work of others. In fact, to any one who did not know him well, this extreme modesty, from its very completeness and unconsciousness, might almost have appeared the result of affectation. At least, speaking for ourselves, when we first met him, and happened to see him conversing with a greatly younger man, quite unknown either in science or literature, we thought it must have been impossible that Mr. Darwin—then the lawgiver to the world of biology—could with honest sincerity be submitting, in the way he did, his matured thought to the judgment of such a youth. But afterwards we came fully to learn that no one was so unconscious of Mr. Darwin's worth as Mr. Darwin himself, and that it was a fixed habit of his mind to seek for opinions as well as facts from every available quarter. It must be added, however, that his tendency to go beyond the Scriptural injunction in the matter of self-approval, and to think of *others* more highly than he ought to think, never clouded his final judgment upon the value of their opinions; but, spontaneously following another of these injunctions, while proving all things, he held fast only to that which was good; in malice be ye children, but in understanding be ye men.

On the whole, then, we should say that Mr. Darwin's character was chiefly marked by a certain grand and cheerful simplicity, strangely and beautifully united with a deep and thoughtful wisdom, which, together with his illimitable kindness to others and complete forgetfulness of himself, made a combination as lovable as it was venerable. It is, therefore, not to be wondered at that no man ever passed away leaving behind him a greater void of enmity, or a depth of adoring friendship more profound.

But, as we have said, it is impossible to convey in words any adequate conception of a character which in beauty as in grandeur can only, with all sobriety, be called sublime. If the generations are ever to learn, with any approach to accuracy, what Mr. Darwin was, his biographers may best teach them by allowing this most extraordinary man to speak for himself through the medium of his correspondence, as well as through that of his books; and therefore, as a small foretaste of the complete biography which will some day appear, we shall quote a letter in which he describes the character of his great friend and teacher, the late Prof. Henslow, of Cambridge. We choose this letter to quote from on account of the singular manner in which the writer, while describing the character of another, is unconsciously giving a most accurate description of his own. It is of importance also that in any biographical history of Mr. Darwin, Prof. Henslow's character should be duly considered, seeing that he exerted so great an influence upon the expanding powers of Mr. Darwin's mind. We quote the letter from the Rev. L. Jenyns' Memoir of the late Prof. Henslow.

"I went to Cambridge early in the year 1828, and soon became acquainted, through some of my brother entomologists, with Prof. Henslow, for all who cared for any branch of natural history were equally encouraged by him. Nothing could be more simple, cordial, and unpretending than the encouragement which he afforded to all young naturalists. I soon became intimate with him, for he had a remarkable power of making the young feel completely at ease with him, though we were all awe-struck with the amount of his knowledge. Before I saw him, I heard one young man sum up his attainments by simply saying that he knew everything. When I reflect how immediately we felt at perfect ease with a man older, and in every way so immensely our superior, I think it was as much owing to the transparent sincerity of his character as to his kindness of heart, and perhaps even still more to a highly remarkable absence in him of all self-consciousness. We perceived at once that he never thought of his own varied knowledge or clear intellect, but solely on the subject in hand. Another charm, which must have struck every one, was that his manner to a distinguished person and to the youngest student was exactly the same: to all the same winning courtesy. He would receive with interest the most trifling observation in any branch of natural history, and however absurd a blunder one might make, he pointed it out so clearly and kindly that one left him in no way disheartened, but only determined to be more accurate the next time. So that no man could be better formed to win the entire confidence of the young and to encourage them in their pursuits. . . .

"During the years when I associated so much with Prof. Henslow, I never once saw his temper even ruffled. He never took an ill-natured view of any one's character, though very far from blind to the foibles of others. It always struck me that his mind could not be well touched by any paltry feeling of envy, vanity, or jealousy. With all this equability of temper, and remarkable benevolence, there was no insipidity of character. A man must have been blind not to have perceived that beneath this placid exterior there was a vigorous and determined will. When principle came into play, no power on earth could have turned him an hair's breadth. . . .

"In intellect, as far as I could judge, accurate powers of observation, sound sense, and cautious judgment seemed predominant. Nothing seemed to give him so much enjoyment as drawing conclusions from minute observations. But his admirable memoir on the geology of Anglesea shows his capacity for extended observations and broad views. Reflecting over his character with gratitude and reverence, his moral attributes rise, as they should do in the highest characters, in pre-eminence, over his intellect."

Charles Robert Darwin was born at Shrewsbury on February 12, 1809. His father was Dr. R. W. Darwin, F.R.S., a physician of eminence, who, as his son used frequently to remark, had a wonderful power of diagnosing diseases, both bodily and mental, by the aid of the fewest possible number of questions; and his quickness of perception was such that he could even divine, in a remarkable manner, what was passing through his patients' minds. That, like his son, he was benevolently inclined, may be inferred from a little anecdote which we once heard Mr. Darwin tell of him while speaking of the curious kinds of pride which are sometimes shown by the poor. For the benefit of the district in which he lived Dr. Darwin offered to dispense medicines *gratis* to any one who applied and was not able to pay. He was surprised to find that very few of the sick poor availed themselves of his offer, and guessing that the reason must have been a dislike to becoming the recipients of charity, he devised a plan to neutralise this feeling. Whenever any poor persons applied for medical aid, he told them that he would supply the medicine, but that they must pay for the bottles. This little distinction made all the difference, and ever afterwards the poor used to flock to the doctor's house for relief as a matter of right.

Mr. Darwin's mother was a daughter of Josiah Wedgwood. Little is at present known concerning his early life, and it is questionable whether we can hope to learn much with reference to his boyhood or youth, till the time when he entered at Edinburgh. We can, therefore, only say that he went to Shrewsbury School, the head-master of which was at that time Dr. Butler, afterwards Bishop of Litchfield. He was sent to Edinburgh (1825) because it was intended that he should follow his father's profession, and Edinburgh was then the best medical school in the kingdom. He studied under Prof. Jameson but does not seem to have profited at all by whatever instruction he received; for not only did it fail to awaken in him any special love of natural history, but even seems to have had the contrary effect.

The prospect of being a medical practitioner proving distasteful to him, he was, after two sessions at Edinburgh, removed to Christ's College, Cambridge, with the view of his entering the Church. He took his B.A. in 1831, and his M.A. in 1837. There being no Natural Sciences Tripos at that time, his degree was an ordinary one. While at Cambridge he attracted the notice of the late Rev. Prof. Henslow, who had just previously exchanged the Professorship of Mineralogy for that of Botany. From the above description of this man's character and attainments, it is sufficiently evident that he was a worthy teacher of a worthy pupil; and the world owes an immense debt of gratitude to him for having been the means of enthusiastically arousing and sagaciously directing the first love and the early study of natural science in the mind of Darwin. No one can be more deeply moved by a sense of this gratitude than was Mr. Darwin himself. His letters, written to Mr. Henslow during his voyage round the world, overflow with feelings of affection, veneration, and obligation to his accomplished master and dearest friend—feelings which throughout his life he retained with undiminished intensity. As he used himself to say, before he knew Prof. Henslow, the only objects of natural history for which he cared were foxes and partridges. But owing to the impulse which he derived from the field excursions of the Henslow class, he became while at Cambridge an ardent collector, especially in the region of entomology; and we remember having heard him observe that the first time he ever saw his own name in print was in connection with the capture of an insect in the fens.

During one of these excursions Prof. Henslow told him that he had been commissioned (through Prof. Peacock) to offer any competent young naturalist the opportunity of accompanying Capt. Fitzroy as a guest on the surveying voyage of the *Beagle*, and that he would strongly urge its acceptance on him. Mr. Darwin had already formed a desire to travel, having been stimulated thereto by reading Humboldt's "Personal Narrative;" so after a short hesitation on the part of his father, who feared that the voyage might "unsettle" him for the Church, the matter was soon decided, and in December of 1831 the expedition started. During the voyage he suffered greatly from sea-sickness, which, together with the fasting and fatigue incidental to long excursions over-land, was probably instrumental in producing the dyspepsia to which, during the remainder of his life, he was a victim. Three years after returning from this voyage of circumnavigation, he married, and in 1842 settled at Down in Kent. The work which afterwards emanated from that quiet and happy English home, which continued up to the day of his death, and which has been more effectual than any other in making the nineteenth century illustrious, will form the subject of our subsequent articles.

(*To be continued.*)

## *ECLIPSE NOTES*[1]

### II.

On the present occasion these notes will be more geographical than astronomical, for since the last notes were written, the English Government Eclipse Expedition has traversed through storm and sunshine the distance separating London from Cairo, and is now at the latter place, making final arrangements before it starts to-night up the great river.

The first thing I have to say, is, that the arrangements made for astronomers of all nations by His Highness the Khedive and by his government have been all that could have been desired. Indeed, so universal has been the wish to do everything that could in any way tend to the success of the observations, that it is almost invidious to mention names; but still it is impossible not to recognise that the sympathy for everything scientific which distinguishes Stone Pasha, the chief of the staff, and the important influence which his high position gives him, has done much in kindling the enthusiasm which we find,—an enthusiasm shared in a great degree by the Khedive himself, who has insisted that the astronomers shall be his personal guests during their sojourn on the Nile. But this is to anticipate; it will be better perhaps, in order to give an idea of the thoroughness with which the arrangements have been carried out, to begin at the beginning of our stay in Egypt.

When the *Kaisar-i-Hind* got into harbour at Suez, after a rapid passage through the canal, a passage accelerated at the request of the Egyptian Government, as the canal had been blocked for three days, the Governor of Suez and Ismatt Effendi at once came on board to welcome the party. A special train had been provided with a car for the instruments, which were at once sealed up and guarded after their arrival at the station in Suez Town. Nothing could exceed the kindness of the authorities; the Custom House, which sometimes gives trouble to those who land in Egypt, was never once even thought of, and after spending the night at Suez, a train brought us yesterday to Cairo, his Excellency Stone Pasha himself, with some of his officers detailed for service with the Expedition, being on the platform to welcome the scientific party. The instruments were at once taken to the river-side, where provision had been made to ferry the car containing them, still sealed, across the Nile.

Acting on a suggestion made some time ago, the exact latitude and longitude of Sohag has been absolutely determined; on the old French map its position had been got by rough traverses from Siut. With this new position and a rapid reconnaissance, a new map has been prepared by General Stone, a copy of which I hope to be able to send with these notes. This shows the point at which the line of central eclipse will cross the Nile with no doubt the greatest possible exactitude. In order to prevent any mischance or delay owing to the low Nile interfering with the arrangements, and causing a loss of time, the steamer placed at the disposal of the astronomers by the Egyptian Government is already moored at Sohag, close to the central line, and indeed the French party are already aboard. Communication between Siut and Sohag will be kept up by the Postal steamers, for the Nile is no longer a river of mystery, and a regular postal service is kept up for thousands of miles. But the hotel steamer, as it is called here, will likewise be locomotive. The French party has already erected its instruments to the south of the arm of the Nile shown below Sohag, and in all probability the English party will occupy the high ground shown on the map to the north of Akmim; a position desirable on account of the Khamseen—the terrible dust-laden desert wind—which, however, this year, up to the present moment, has been very merciful; this we may regard as a good or bad presage during the next fortnight, to which its devastating effects are generally confined.

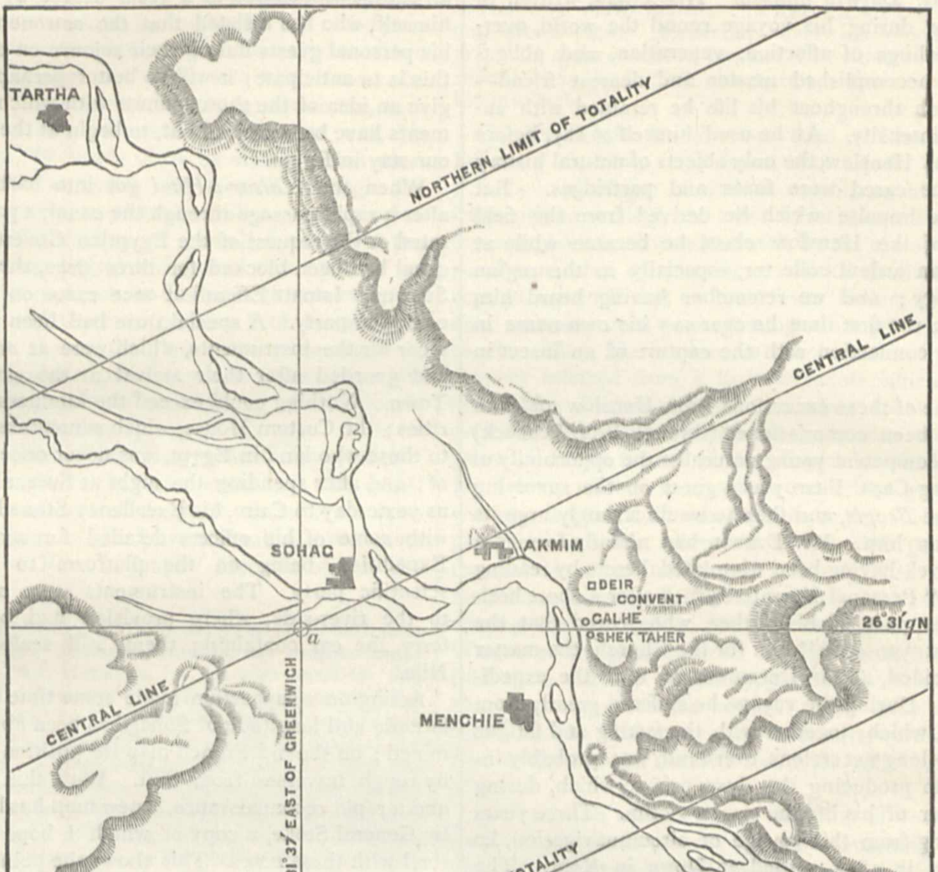
Between these stations the special boat will keep up constant communication.

The Italian Expedition is under the charge of Prof. Tacchini, of Rome, whose long-continued observations of the spectra of prominences are so widely known and

[1] Continued from vol. xxv. p. 578.

well appreciated by men of science. He has brought out a small equatorial telescope with spectroscope attached, and it is believed, intends to devote himself exclusively to spectroscopic work during the eclipse. He joins the eclipse boat a few days later on.

The French party consists of MM. Thollon, Trépied




Director of the Observatory at Algiers, and M. Buisseux; as above mentioned, they are already at their station; their work will be chiefly spectroscopic.

The Egyptian Government has deputed Moukhtar Bey, Colonel on the Staff, to assist the English party at the place of observation.

J. NORMAN LOCKYER

Cairo, May 5

(*To be continued.*)

## THE TOTAL ECLIPSE

THE following telegram in the *Times* of to-day from its Special Correspondent with the English expedition to Egypt, gives the following results of the observations of the total solar eclipse of yesterday:—

*Sohag, May* 17

The total eclipse of the sun was successfully observed here to-day by the English, French, and Italian astronomers.

A fine comet was discovered close to the sun, its position being determined by photographs.

The spectroscopic and eye-observations just before and during the period of totality gave most valuable results, the darkening of the lines observed by the French astronomers indicating a lunar atmosphere.

A series of good photographs of the corona was obtained, and the spectrum of the corona for the first time was successfully photographed.

The astronomers will probably leave on Saturday on board the Government steamer.

## THE THEORY OF DESCENT

*Studies in the Theory of Descent.* By Dr. Aug. Weismann. Translated and Edited by Raphael Meldola, F.C.S. Part III. The Transformation of the Mexican Axolotl into Amblystoma; On the Mechanical Conception of Nature. (London: Sampson Low, Marston, Searle, and Rivington, 1882.)

THE present issue completes the excellent translation of Dr. Weismann's valuable and suggestive work. The first two essays of which it consists is devoted to a careful discussion of the real meaning of the transformation of the Axolotl into Amblystoma. Experiments are detailed showing that the metamorphosis may be induced with much constancy by obliging the Axolotls, at a proper stage of growth, to leave the water, when they lose their gills and undergo a number of other changes constituting a veritable metamorphosis. Dr. Weismann states that many zoologists have expressed an opinion (which was formerly held by himself) that this change is to be considered to be a true advance in development from a species which had hitherto remained in the larval stage, but which, through the influence of certain changed conditions, now advances, *per saltum*, to a higher stage. This view he gives many excellent reasons for considering to be quite erroneous; holding that the facts are best interpreted by supposing that the animal formerly underwent metamorphosis, but that owing to changed conditions it was unable to survive in the perfect state, and therefore remained in the larval condition in which it acquired the power of reproduction.

The causes which led to this change are believed to be a progressive drying up of the Mexican lakes (as long since proved by Humboldt), and a consequent increased aridity of the atmosphere inimical to land amphibia. The axolotl, therefore, presents us with a case of degeneration; and its metamorphosis under changed conditions in confinement is not due to any advance in organisation, but is really a reversion to a not very remote ancestral habit. The whole of the facts at present ascertained with regard to these animals and allied forms in their native habitats, are shown to agree well with this view, which is quite in harmony with the author's explanation of seasonal dimorphism in butterflies, given in Part I. of the same work (see NATURE, vol. xxii. p. 141), and is also more in accordance with the true principles of evolution than the alternative hypothesis.

The second, and concluding essay, is entitled "On the Mechanical Conception of Nature," and is chiefly occupied with an inquiry into the true character of variation as the chief factor in evolution, and into the comparative importance of external conditions, and the constitution of the organism in determining the particular direction of the course of development; the object being to show that all takes place according to fixed laws without the interference of any "teleological principle," whether in the form of a "phyletic vital force" or the interposition of any "designing power." The writers whose views on these subjects are combated are Von Hartmann and Karl Ernst von Baer, and, after an elaborate and often subtle argument, Dr. Weismann concludes that the facts can all be explained on "mechanical" principles, or, as we should say, by the action of fixed laws. He is however careful to add that this does not imply a materialistic view of nature. "Those who defend mechanical development will not be compelled to deny a teleological power, only they would have, with Kant, to think of the latter in the only way in which it can be conceived, viz. *as a Final Cause.*" And on the great question of the nature and origin of consciousness he thus expresses himself:—"If it is asked, however, how that which in ourselves and in the remainder of the animal world is *intellectual* and *perceptive*, which *thinks* and *wills*, is ascribable to a mechanical process of development—whether the development of the mind can be conceived as resulting from purely mechanical laws? I answer unhesitatingly in the affirmative with the pure materialist, although I do not agree with him as to the manner in which he derives these phenomena from matter, since thinking and extension are heterogeneous things, and one cannot be considered as a product of the other." And he intimates that the fundamental notion of conscious matter may get us out of the difficulty. However this may be, he maintains that the theory of selection by no means leads—as is always assumed—to the denial of a teleological Universal Cause, and to materialism, but only to the belief that any mode of interference by a directive teleological power, other than by the appointment of the forces producing the phenomena, is, to the naturalist, inadmissible. "The final and main result of this essay will thus be found in the attempted demonstration that the mechanical conception of Nature very well admits of being united with a teleological conception of the Universe."

The work, of which the translation has now been completed by Mr. Meldola, must be considered a very important contribution to the theory of Natural Selection, since it applies that theory to explain in the minutest detail how the more prominent characters of several distinct groups of animals, not obviously useful to them, may have been developed under its action. Such are the distinct markings often occurring in two annual broods of butterflies termed "seasonal dimorphism," the origin of the markings of caterpillars, and the unexpected phenomena of the transformation of the Mexican axolotl; and we are therefore led to conclude that an equally careful and minute study of other cases of difficulty would probably lead to an equally satisfactory explanation. This argument is not, however, conclusive, because the cases here chosen may not be really test cases; and among the countless forms of nature, and especially among the higher animals, there may well be characters or organs the origin of which are due to other and altogether unknown causes. To students of evolution, Dr. Weismann's volume will be both instructive and interesting, but it is a work that requires not merely reading, but study, since its copious facts and elaborate chains of argument are not to be mastered by a hasty perusal. The book is beautifully got up and illustrated by a number of coloured plates admirably executed in chromo-lithography, and it will form a handsome as well as an indispensable addition to every naturalist's library.

ALFRED R. WALLACE

## OUR BOOK SHELF

*Land and Freshwater Mollusca of India.* Edited by Lieut.-Col. H. H. Godwin-Austen, F.R.S., &c. Part I. February, 1882. (London: Taylor and Francis.)

THIS work is announced as "supplementary to Messrs. Theobald and Hanley's 'Conchologia Indica,'" but it is much more than a supplement, and is framed on far more scientific principles. The "Conchologia Indica" was published in 1870; and the editors in their preface say that "after an interval of two or three years it is hoped that materials for a supplement (the malacological portion of which will be edited by Major Godwin-Austen) will be accumulated." The "Conchologia Indica," however, is only what it professed to be—"Illustrations of the Land and Freshwater Shells of British India." The letterpress gives a dry list of species and synonyms, not arranged in classified order, with occasional notes. This is admitted by the editors, who state that they "do not acknowledge the validity of many of these species, but merely illustrate them." They also state their "regret that the figures of some of the more minute shells are not so well executed as they expected; but lithography is scarcely compatible with sharp definition." We fully concur in the last remark. Although this is not a review of their work, we cannot help noticing the fact that certain species of freshwater shells belonging to the northern portion of British India, and which are enumerated in the "Conchologia India," are also natives of Europe. Such are *Limnæa auricularia* and *stagnalis* of Linné, *L. peregra* and *truncatula* of Müller, and *Valvata piscinalis* of Müller; but there is no species of *Unio*, *Anodonta*, *Sphærium*, or *Pisidium* common to the two regions. The occurrence of the first-named five species in countries so geographically and widely separated, may be partly explained by these species having spread from Siberia, which they likewise inhabit; but the mode of their original distribution from Europe to Siberia, or *vice versâ*, still remains a problem. If water-fowl or other animals had been instrumental in such distribution, why should not any of the freshwater bivalves, which are likewise European and Siberian, have been similarly transported to British India?

The present work is intended to be published in parts, of which the first has now appeared. It contains seventeen octavo pages of letterpress and four quarto plates. The descriptions of new species, as regards both the shell and soft parts or animal, have been most carefully written, and the author has properly given the distinctive characters of each species in a correlative order, which is a point of material assistance in comparing one species with another. There are, nevertheless, a few exceptions to this useful rule in species of *Kaliella* and *Microcystina* (pages 5, 12, and 13), where the umbilicus is described first, and before the shape of the shell. The shells are admirably drawn, although the colouring is unsatisfactory. Without having critically studied the specimens figured, and especially "a hatful" of them, one might, on looking at the illustrations, be inclined to question the specific distinction of several. But all naturalists are never likely to agree in that matter; and perhaps it may be immaterial whether certain forms are called species or varieties. The minds of some naturalists have a synthetic and of others an analytic tendency.

Col. Godwin-Austen seems to attach considerable importance to the odontophore or lingual riband as an element of classification. We believe that this affords a good auxiliary character in defining genera or higher groups of the Solenoconchia and Gastropoda; but the recent investigation of the subject by Herr Friele in respect of northern species of *Buccinum* shows that the odontophore varies so greatly in individuals of the same species that it cannot be fully relied on for distinguishing species. Some Gastropods, *e.g. Odostomia* and *Eulima*, have no odontophore, in consequence of their food consisting of soft polyparies.

The work now noticed is a very valuable contribution to the natural history of India, and has been intrusted to a naturalist who is by no means less competent because he is actuated by modest aspirations.

J. GWYN JEFFREYS

*Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux.* 2e série, tome iv. 3e cahier. (Bordeaux, 1881.)

THIS cahier contains nine papers, all mathematical. We recently called attention (vol. xxv. p. 408) to an article in the second cahier, by M. Paul Tannery, on the Arithmetic of the Greeks. The same writer now furnishes two contributions—one, "Sur la mesure du cercle d'Archimède," in which he discusses how far Archimedes (in his κύκλου μέτρησις) was acquainted with methods which form the base of the solution of what is now called the Pellian problem; the second is entitled "De la Solution Géométrique des problèmes du second degré avant Euclide," and in it he discusses questions very nearly allied to those considered by Dr. Allman in his "Greek Geometry from Thales to Euclid."

M. Ordinaire de Lacalouge also contributes two papers—one on the tramways of Bordeaux ("en regardant poser les rails et marcher les premières voitures des tramways on a tout naturellement là l'idée de rechercher le rayon minimum des courbes où ces véhicules peuvent circuler. Ils ont, sous certains rapports, de l'analogie avec les wagons de chemin de fer, mais en diffèrent, surtout par leur vitesse de translation"); the second discusses the "théorie géométrique du pendule de Foucault" as against M. Yvon de Villarceau; it is modestly written, and is valuable from its furnishing many interesting historical references. Regarding the views broached in the article, the author concludes with "le temps dira si c'est une illusion."

M. Kowalski, in a "Note sur les systèmes coordonnés d'unités électriques spécialement sur celui de l'Association Britannique et ses applications," does good work in giving a concise elementary account of these systems of units, "notions que les traités classiques de physique publiées jusqu'ici en France passent à peu près complètement sous silence."

The remaining four papers are by M. Saltel, viz. "Réflexions sur la mesure du volume de la sphère" (with a demonstration); "Étude de la variation du cercle osculateur en un point M d'une section plane d'une surface"; "Théorèmes généraux sur la décomposition des enveloppes, théorème sur les surfaces développables"; "Contribution à la théorie du changement des variables dans le calcul des intégrales simples et multiples."

*On and Off Duty: being Leaves from an Officer's Note-Book.* By S P. Oliver. (London: W. H. Allen and Co., 1881.)

THE chief contents of this handsome volume are derived from the rough notes and sketches made by Capt. Oliver, some years ago, when a young subaltern of artillery. They show that, whether in Turania, Lemuria, or Columbia, he took notes of all the strange things he saw, and although many of his observations have appeared from time to time in the journals or proceedings of various societies, or as articles in periodicals, they were, we think, interesting enough to be collected into a more permanent form, which we trust may stimulate others of Her Majesty's officers to follow Capt. Oliver's example.

The first part of the volume is devoted to an account of the author's visit to China and Japan. There is a graphic description of the visit to Tsing-Yuen, to see that the treaty (1860) of peace was properly posted up as required. Snakes are mentioned as abounding; and we learn that snake's flesh is eaten from choice not rarely by the Chinese: indeed, boiled-snake soup is a favourite febrifuge for invalids. The author says that at Shao-K'ing numerous bodies of the rebels were floating past with the stream, and that though the majority were decapitated, all the bodies of the men floated on their backs, whereas all the bodies of the women floated "face downwards." The notes on Japan are of interest, as intercourse with foreigners is so improving the Japanese, that such peculiar games as Jon-noki are not now-a-days to be commonly seen played: and the author was fortunate to see Yeddo ere it ceased to be the exclusive city.

The second part is taken up with a visit to Lemuria, thereby meaning Madagascar and the Mascarene Islands of Bourbon and Mauritius. This visit was made in 1862. The Seychelles were not visited. Some noteworthy details are given of a visit to Madagascar. The home of the *Ouvirandra fenestralis* is well described, and the account of a Mauritius hurricane is true to the life. It is mentioned that in the hurricane of March 12, 1868, the iron girders, 200 feet in length, and weighing over 300 tons, were blown from the railway bridge over Grande Rivière, when a force of 100 pounds to the square foot must have been exerted by the wind down the ravine.

In an appendix to the second part, there is a chapter on the natural history of Madagascar, contributed by Mr. J. G. Baker, F.R.S., of Kew.

The third part of the volume describes a visit to Columbia along with Capt. Pim and Mr. John Collinson, for the promotion of a transit railway route through Mosquitia and Nicaragua.

The volume will commend itself to the general reader, and the scientific notices mentioned therein will be found very generally interesting and correct.

*Modern Metrology*. By Lowis D'A. Jackson. (London: Crosby Lockwood, 1882.)

It is no easy task to give an account of the various systems of weights and measures in use throughout the world, to trace their origin, and to express their equivalents in English and French weight and measure, but this the author has undertaken in one part of his book, and has brought together much valuable and interesting information. This work is so far a cambist or dictionary of weights and measures, both the scientific and commercial equivalents of all foreign units being given. It would have been well, perhaps, if the author had stated for each country the precise authority from which he obtained his equivalent, as works of this kind should as far as possible contain within themselves means for verifying the accuracy of the figures given.

The main object of the work appears, however, to be the discussion of a remedy for the evils of the complex systems of weights and measures which are unfortunately still in use in this country. To provide such a remedy is a serious task, and one well worthy of the attention of a great statesman such as Mr. Gladstone, to whom this work is inscribed.

The author discusses the vexed question of the relative values of standard temperatures at 32° and at 62°, and proposes a new English system based on a cubic foot of 1000 "fluid ounces," at the temperature of the maximum density of distilled water.

The "fluid ounce" is taken as equal to the weight of distilled water contained in a cubical vessel whose dimensions are equal to a "tithe," or tenth part of the linear foot, when weighed and measured also at the temperature of the maximum density of distilled water. The various parts and multiples of the cubic-foot and "foot-weight" would be built up by decimal progression, so that a strict correspondence would be always maintained between capacity, linear dimension, and weight. The effect of reducing the temperature of the cubic foot from 62° F. (the present legal temperature) to 39°·1 F. (the temperature of the maximum density of water), would bring the weight of the cubic foot more into accordance with modern research, as it would raise its weight from 62·321 lb. to 62·424 lb.

Although we have faint hope of present success in disturbing the deeply-rooted systems of measures now in use by this great commercial nation, or of substituting for the purposes of international science a more acceptable metrology than that based on the metre and gramme, we cannot but recommend this work to the consideration of all interested in the practical reform of our weights and measures.

## 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.*]

### Sun-Spots and Magnetic Storms

Some particulars of the remarkable double outburst of sun-spots in the latter part of April and of the magnetic disturbances which appear to have been connected with them, as recorded at Greenwich, may be of interest to your readers. It is in itself a noteworthy fact that there should be on the sun at the same time two spots, one of them double, sufficiently large to be visible to the naked eye, and this is made still more interesting by the occurrence of a violent magnetic storm a few days after the appearance of each of these large spots.

The larger of the two spots would seem to have first made its appearance at the east limb on April 11 at about 15h. G.M.T., though no photograph of it was obtained till April 14. It must have passed off the disk about April 25 8h., being well shown on a photograph on April 24. It extended over 10° of heliographic longitude, and measured more than 2' of arc in length and breadth.

The group preceding it, consisting of two spots, was first photographed near the east limb on April 11, and was then comparatively small. Between April 16 and 17 it increased suddenly in size, becoming nearly as large as the other spot group, and far exceeding in area any of the spots previously recorded at Greenwich.

The areas of these groups on the photographs, expressed in millionths of the sun's visible hemisphere, and corrected for foreshortening were as follows:—

| 1882. | Great Spot | | Preceding Group. | |
|---|---|---|---|---|
| | Nucleus. | Whole Spot. | Nucleus. | Whole Spot. |
| April 11 | | | 17 | 141 |
| 14 | 351 | 2218 | 40 | 270 |
| 16 | 239 | 2086 | 24 | 156 |
| 17 | 391 | 1979 | 204 | 880 |
| 18 | 465 | 2030 | 244 | 1370 |
| 20 | 340 | 1916 | 294 | 1813 |
| 21 | 427 | 2105 | 440 | 2360 |
| 23 | 267 | 1786 | 167 | 1054 |
| 24 | 316 | 1727 | | |

The total spotted area on 1882, April 17, was 881 for the nuclei, and 4668 for the whole spots, being about double of the greatest spotted area shown on any of the Greenwich photographs previous to this outburst.

On April 16 and 19 violent magnetic disturbances occurred. At Greenwich the declination, horizontal force, and vertical force magnets became violently disturbed on April 16 at 11h. 30m. G.M.T., the first movement for all three being simultaneous and sudden, and the storm movements continued till April 17, 7h. 30m. G.M.T. The magnets remained quiet till April 19, shortly after 15h. 30m. G.M.T., when another sudden and very sharp disturbance commenced, lasting till April 20, 20h. G.M.T.

In the magnetic storm of April 16-17, there were large oscillations of declination till April 17 0h., the greatest *recorded* motion being about 1°, from a diminished declination at 19h. + to an increased declination at 19¾h. Then until 4h. the register cannot be traced, the motions being either unusually rapid, or the magnet being disturbed by workmen in the upper room. About 7h. there were some sharp motions, after which time the magnet became quiet. The principal feature of the disturbance of horizontal force was at first an increase, followed by a much larger diminution, amounting to about 1-50th of the whole force at 16h., when the trace went off the sheet, and was lost until April 17 0h. There was then a great and rapid increase (in about 40m.) of about 1-40th part. Rapid motions were then shown till 7h. 30m. The whole range of these disturbances probably exceeded 1-25th part of the whole force. The vertical force at first decreased somewhat till April 16, 16h., and afterwards very considerably till about 18h., when it was diminished by about 1-100th part, then with the horizontal force it increased till about 1h., when the trace went off the sheet, its value being then greater than the normal by more than 1-100th part. Finally, the normal value was gradually reached again at 7h. 30m.

In the second magnetic storm, the range of the declination movements was 1° 30′, of the horizontal force about 1-50th part of the whole, and of the vertical force about 1-120th part.

Thus the vertical force disturbance on April 19-20 was comparatively small; that of the vertical force on April 16-17 is characteristic of the greatest storms, and since the great disturbances of 1872, February 4, and those of October 4 of the same year, no magnetic storm has been recorded equal to this. Earth-currents were shown throughout both storms.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, May 8

## Hypothetical High Tides

I REGRET that I am not able to accept the criticisms of Mr. C. Callaway on my notice of Prof. Ball's lecture. I have studied the effect of tidal and wind waves on many coasts through many years, and my observations do not warrant the statements he makes. Every schoolboy knows the distinction between waves of undulation and translation, and it is in no sense true that I have confused them. With waves of undulation such as occur in mid ocean we have nothing to do in this discussion, but it cannot be unknown to Mr. Callaway that all such waves when reaching a shore, become waves of translation, and more or less powerful denuding agents. If he will have the kindness to refer to my "Report on the Geology of Ohio," vol. i. pp. 52, &c., he will find that I have done ample justice to the efficiency of wind waves as agents of geological change. The great tidal current rushing around the earth, with which he credits me, exists only in his own imagination. I have suggested nothing of the kind, but the rapid ebb and flow over the shores of continents of tidal waves several hundred feet in height must necessarily act with great violence upon such shores, and I insist that such tidal waves as pictured by Prof. Ball would have left a very different record from that we find in our Palæozoic rocks. Some of our American Silurian strata were deposited on shores that faced toward the east, where they had an unbroken stretch of several thousands of miles of ocean over which the tidal wave would come to them without obstruction, and there the maximum effect of such tides as Prof. Ball describes would be produced, but no traces of them are found.

I am aware that the reef-building corals of the Devonian were zoologically distinct from any now living, and for that reason conditioned my inference from them; but we have satisfactory evidence that the Devonian coral reefs of Ohio and Kentucky were formed *along a shore* and in a *warm* sea, like the reef-building corals of the present day, and there are many reasons for believing that their mode of life was the same.

The point made by Mr. Searles Wood in regard to the coal, though objected to by Mr. Callaway, is well taken, for we know that the great coal marshes of America were located just at the sea level, and from time to time were inundated by the sea and covered with sheets of *marine* limestone. It requires no argument to show that the growth of the Carboniferous forests and the formation of beds of peat—now coal—could not have taken place with tides rising one-half or even one-fourth of the height of those described by Prof. Ball.

On carefully reviewing the facts which suggested my objection to Prof. Ball's theory, I am compelled to reiterate the statement before made, that on the east coast of North America the geological record bears positive and conclusive testimony against the high tide theory, and that at least since the Archæan ages no tides have swept this coast like those required by Prof. Ball's theory, even as modified by Mr. Darwin.

New York, April 10 J. S. NEWBERRY

## Aurora Borealis

A POLAR aurora of remarkable activity and brilliancy was observable here at 11.15 last night. The centre of energy at the time of origin was under Cassiopiea, a highly luminous streamer shooting upwards from the horizon, and covering, but not hiding the stars in that constellation. Brilliant white flickering streamers and rays, arising from the horizon, quickly spread towards the north-west, and an irregular shaped mass of crimson light, of an altitude of 45°, and many degrees in breadth, appeared, and suffused the northern hemisphere from Cassiopiea to Gemini. Between the horizon and the mass of crimson-coloured vapour the sky was of a light green hue, and upwards, through this area of greenish light, the rays and streamers shot.

During the period of greatest energy, a beam of vivid light arose towards the north-west, was projected over Gemini, and quite extinguished the light of the two large stars in that constellation. About midnight the meteor faded. Soon afterwards the sky became overcast. Throughout the day the wind had been blowing briskly and coldly from a point in the north-east. Barometer, highest during the day in the shade, 60; aneroid, 30·2. In the afternoon, curious slender-rayed cirri from the north-west, generally indicative to my mind of auroral disturbanie, crossed the northern sky towards the zenith. To-day, detached clouds and blue sky, and the wind is blowing stiffly and icily from the same point. Barometer and aneroid same as yesterday, the latter inclined to full.

An auroral display of the like splendour and activity is very rare, if not wholly unknown in this locality at this time of the year. X.

Worcester, May 15

AT 10·55 p.m. last night, I observed a very beautiful aurora borealis, consisting mainly of three beams, nearly vertical, and then parallel to the direction of the stars $\alpha$ and $\delta$ of the Great Bear. They moved slowly towards the east, and about 11·5 faded away. About 11 o'clock they were very brilliant, and the central beam, then quite close to the Polar star presented a slightly purple or violet colour, as represented in the sketch inclosed. Near the earth, and at about 15° to 20° elevation, there was a mass or cloud of suffused light, from which the beams seemed to rise. It seems that an aurora was also seen about a fortnight ago from Dublin. The wind has been easterly, and to-day is somewhat colder than yesterday.

J. P. O'REILLY

Royal College of Science, Dublin, May 14

## Spectrum of Wells' Comet

THE continuous spectrum of this comet, especially of the nucleus, is remarkably bright. I observed it on April 18 and May 6 and 15. There were at least three bright bands, and perhaps more. I believe the usual three were visible, but they were so indistinct that I did not observe their positions. The middle one was much the brightest, and the only one plainly visible. I never saw a comet in which the bright bands were so faint, relative to the continuous spectrum.

May 16 T. W. BACKHOUSE

## The Recent Violent Storm

MAY I ask your permission to insert from me a curious circumstance, which came under my notice, soon after the tremendous storm which took place on Saturday, April 29 last. On the glass of some of the windows of the house in which I reside I perceived a very singular appearance upon them, somewhat resembling a deposit from milk. On looking at it through a microscope I discovered a number of very beautiful crystals, which, without doubt, were caused by the spray from the sea, as on applying it to the tongue, there was a strong taste of salt. The distance the spray must have been carried on this occasion could not have been less than sixty miles, taking into consideration the course of the wind, which was south-west.

NATHANIEL WATERALL

Waddon, Croydon, Surrey, May 15

## The Cuckoo

Is it a normal habit, or only an erratic freak of that quaint bird, the cuckoo, to sing at night. On the night of Monday, the 8th inst., I first heard, at 10 p.m., three or four calls, but took little notice of it, thinking the bird had been startled from his dreams, but in a short time he recommenced, and went on continuously with short intervals of silence, until 12 or 1, precisely as by day.

It was a dark night with only dim starlight. I should like to know whether others have remarked this nocturnal loquacity in the cuckoo. This particular bird has usually commenced his song or call at about 4 a.m. J. E. A. BROWN

May 11

### The Swedish Fisheries

In NATURE of April 20 you ask for an explanation of the difference in the figures of Dr. Oscar Dickson and Dr. Lundberg relating to the Swedish fisheries.

1. You mention that Dr. Lundberg, in the "Notizen uber die Schwedischen Fischereien," 1880, valued the herring fisheries of Sweden at 5,000,000 marks (3,547,303, p. 27), but you forget that Lundberg's book only refers to the "Ostsee und Sussvasser Fischereien," and Dr. Dickson only speaks of the west coast or North Sea fisheries.

2. About the "millions of barrels representing millions of pounds sterling," the Swedish North Sea Herring Fisheries statistics value the barrel herring *now* only at 1 to 2 shillings in the first (fisherman's) hands. And you will notice that the millions of barrels mentioned by Dr. Oscar Dickson in the *Scotsman*, refer to a former period, nearly a century ago, not to the present period, commenced 1877.

Pyphis, Sweden, May 3 GERHARD VON YHLEZ

## THE OLDEST EGYPTIAN TOMBS AND TENANTS

ALTHOUGH the existence of mankind in the dawn of civilisation at the Stone age, and using Palæolithic tools is distinctly proved in Northern Africa and Algeria, the specimens discovered on the soil of Egypt are not so unequivocally Palæolithic, although those published by Sir J. Lubbock approach the type. Of the Neolithic stone weapons, numerous examples have been found, some undoubtedly in use at the time of the eleventh and twelfth dynasty, others probably descending to the eighteenth and nineteenth dynasties. The indications, however, of sepulchres of the Palæolithic period are absolutely wanting on the soil of Egypt, and except the stone huts in the Arabian Peninsula, belonging to the more ancient period, there are no remains of contemporary construction.

In the graves around the oldest pyramids Neolithic remains are occasionally found, and there can be no doubt that flint weapons were extensively used at the oldest pyramidal period, which, however, was one of copper and bronze, copper and even iron objects having been found in the air passages of the great Pyramid, and indications of the use of the hollow bronze drill in the stone sarcophagi of the same epoch. The pyramids were arranged chequer-wise in groups, and each separate site belonged to a different dynasty, the kings and other royal personages being inhumed in them, while around the pyramid of each site were arranged the tombs of the courtiers and officers of the court. The arrangement of these tombs differs at the respective sites. At Sakkarah they are arranged in rectangular groups of streets, and the same arrangement prevails at Gizeh. At Abusir the last undulations of the step-shaped hills which crown the pyramids are occupied by some tombs scattered about of the time of the fourth and fifth dynasty. At Dashour there are also some tombs of a very early and unknown period, and at Meidum, tombs of the third dynasty. All these tombs bear a general resemblance to each other, and pass by the general Arab name of *mastabas*, "counters," or "beds." At first sight they look like the pedestals of pyramids, or truncated pyramids, being of rectangular shape, with sloping sides; they are, however, not square, but rectangular, and the angle of the sides is so great that the walls, if produced upwards, would rise to 600 feet, an impossible height for such a construction. Consequently they are not of the class of pyramids, but only show the Egyptian preference for converging lines, instead of purely parallel or rectangular forms; the short sides also in some instances are step-shaped, the layers of stone are squared and laid in horizontal courses, and not polygonal m sses. These rectangular masses of masonry or brick-work, the details of which will be subsequently described, did not contain the sepulchral chamber, for that is always found in the solid rock beneath, the access to which was by a rectangular shaft or well, down which the coffin and mummy were lowered by ropes; the mass of masonry above had only in it the sepulchral chamber and the cell for the sepulchral statue. The general "cemetery," with its street of tombs, was called in Egyptian *kher* or *khel*; the individual tombs bore the general name of *maha* "sepulchres," which was applicable to any class of tomb, whether those of the kings or used by the inhabitants of the town or city. The term *mer* was applied to any tombs which had pyramidal construction, as those made of brick with pyramidal tops cut out of the flank of the hill at the time of the eleventh dynasty at the Drah Abu'-l Neggah, in the western quarter of Thebes; but the term applied to the syringes or hollowed passages and tunnelled tombs at Gournah and elsewhere is *asi*, a word applied to a plant, perhaps a "reed," but also meaning a chamber, and this word was used to express the so-called mastaba, or quadrilateral sepulchre of the early dynasties. The great necropolis of Sakkarah is supposed to be that of the ancient Ka-Kam, the city of the Black Bull, known to the Greeks under the name of Cochome, and the pyramid there to have been named *Ap*, the "elevation" or "Mount," and the pyramid was step-shaped, made of unbaked brick, probably when first built in seven stages.

The mastabas were the mausolea of the richer and more important personages of the court hierarchy and Egyptian bureaucracy, for the poor and slaves were not buried with any consideration; they were hustled into superficial graves about three feet deep beneath the soil, and at this distant period of time are found only as skeletons, with no linen wraps remaining or other traces of emblems, and must therefore be regarded as the oldest and most primitive examples of Egyptian interment, and their bodies were unprovided with coffins. Occasionally, perhaps, some of the least poor, or slaves of extraordinary merit, had rectangular vaulted chambers, constructed of brick-work, vaulted and covered with a white coating; in the interior of these rude graves are found small vases or cups of coarse pottery or calcareous stone or alabaster, but uninscribed. These graves recal to mind those of the later Roman period, although the Memphian ones belong to a period long anterior.

The mastabas vary in size and dimension, but their average or normal dimensions are nearly fifty yards long, twelve yards wide, and thirty deep. The chief of these mastabas is the Mastabat-il-Pharaoun, which recent discoveries show to have been the sepulchre of Unas of the fifth dynasty, who was not buried in a pyramid. The mastabas are said to be peculiar to Gizeh, and not to be found elsewhere, and a long interval of civilisation must have preceded the construction of these tombs, as they show a considerable knowledge of architecture by their regular and geometric construction, while the square blocks and regular layers, each vertical joint being overlapped by a square stone, evidence considerable technical experience in the art of masonry. The other mastabas are made of similar masses of brick-work, and the bricks are of two kinds, those of the oldest mastabas, made of rectangular yellow bricks, composed of sand, pebbles, and some Nile mud, their dimensions being $22 \times 11 \times 7$ of a metre, and black bricks made of alluvial soil and straw, larger in size, being $38 \times 18 \times 14$ of a metre; these bricks are not older than the middle of the fourth dynasty, while the others are as old as the second line. The black bricks continue till the time of the Romans, and both kinds are sun-dried, no burnt bricks, with the exception of the conical stamped bricks, found at the tombs of the Drah-Ahi' l'Neggah, having been employed in constructions till the age of the Cæsars.

In the masses of brick-work or masonry which stood above the soil over the sepulchral chamber, hewn out of the solid rocks beneath, were constructed the mortuary chapel, for the performance of masses or liturgies to the dead, which, however, must have been of a simpler nature than those in use at a later period. In all these mastabas which, as a rule, face northwards, generally towards the north-east angle, is a kind of stele or sepulchral tablet of limestone, some times like facade, composed of separate pieces, and having two square pillars or columns in front, without capitals or abaci, forming a kind of entrance hall. This part of the mastaba is rarely on the south, never on the west, and the ceiling is always continuous, sometimes slightly vaulted by the stones supporting one another. The tablet is often like a door, with jambs, lintels, and hieroglyphics; sometime the facade or stele has a kind of false door with large figures of the occupant of the tomb and his wife at the sides of the false door, with a semicylindrical tambour above the door and a kind of cornice above that, with a sepulchral dedication to Anubis, never to Osiris, and representations of the person for whom the sepulchre was made, at a repast or some other diversion, as the fowling represented on the mastaba at Meidum. On the portion of the soil covering the serdab or inner niche and the well by which the sarcophagus and its mummy were lowered, are found little vases filled with a coating containing inside the trace of the water with which they were filled. The interior chapel or *asi* was either single, or had more than one chamber, and the walls of these were covered with pictures and inscriptions engraved in intaglio and brightly coloured, still vivid after 6000 years, but no furniture itself or offerings are discovered in the rooms, which have been long open to the spoiler. The inscriptions refer to the calendar and festivals throughout the year, the titles of the deceased, adoration to Anubis, and tables of food, or *menus* in use at the period; and the gourmands of the Egyptian aristocracy fared sumptuously every day out of well-filled flesh-pots and jars of wine and beer. The paintings on the walls depict the chase, the farm, the industrial household, the amusement of dances by professional women, games, and other diversions, and were no doubt intended to recal to the spirit of the dead his favourite occupations and his former wealth. Such solaces were reserved for the rich; the poor reposed after death about as indifferently as during life.

When constructed of masonry, the walls of the chapel in the mastaba were often made of rubble revetted, and at the end, at the foot of the false door is often found the stone altar of libations, sometimes with two small obelisks engraved only on one face; at other times, instead of obelisks, two supports in the shape of altars. The stele or sepulchral tablet was at the earliest period made in shape of a facade, but often quite blank, a mere white slab. It is not till after the sixth dynasty that these tombstones were rounded at the top, like those of the present day. When the chapel was ornamented, the tombstones are often blank; when the walls of the chapel—the *asi*—were unadorned, the tablets were often inscribed. In the most ancient tombs the tombstones are often built up of pieces and are inscribed with hieroglyphics of an early and rude type. The art is bad, and the inscriptions are not in regular lines, but dispersed over the area; the hieroglyphics themselves are often peculiar, executed with more elaborate detail than at the later period of the middle Empire. The object of these early inscriptions is to record the name and titles of the departed, and it is remarkable that at this period persons had the *ran-āā*, or "great name," and the *ran-nets*, or "little name." A tomb, for example, of the second dynasty, at Sakkarah, was made for a man whose great name was Sekarkhabau, or "Sochari's rising amongst spirits," whose small name was Hothes—that of a rat or some small animal; and his wife's great name was Atherhotep, and her little name Teps; and this as early as the second dynasty. These chapels now have no doors, if they ever had, and except the vases found strewed here and there on the floor, the other objects which may have been deposited there have entirely disappeared. Behind the wall, on the south side more often than the north, and on the north more often than the west, was a secret niche, which the Arabs call the *serdab*, occasionally communicating with the chamber by a square orifice. In this niche was deposited a statue of the deceased. In this statue was supposed to reside his *ka*, or spirit, a kind of manes, or ghost, which inhabited the tomb, went in and out of the sepulchre and Hades, and to which was attached a priest, who performed the liturgies or litanies, in certain ways, and with peculiar rites. In the earlier inscriptions this ka is not mentioned, but at the close of the twelfth dynasty, all the benefits conferred by deities on the deceased were said to be due to his *ka*. It was in this chapel and to this image that the ancestral worship was paid, and the *ka*, which was a kind of *idolon* of the dead, was supposed to receive the same satisfaction as the dead himself. Most of the statues in the museums of Europe at the time of the fourth and sixth dynasties, came from the serdab of the sepulchre of the period. They were portraits of the dead, and sometimes represented him holding the tools or other marks of his profession. The whole of the mastaba, or chapel, and its mass was superposed on the real sepulchral chamber beneath, which it covered. The descent to this was by a rectangular well or shaft, from six feet six inches, to nearly ten feet square, and this cell passed through the masonry or platform of the mastaba, and then through the living roots of the foundation, and was made of large blocks; it was down this well that the sarcophagus was lowered to the chamber, by a shaft from thirty to seventy-five feet deep. Hence, at the base of the shaft, a short passage led to the rectangular chamber, which was well built, but has only once been found uncemented, and in it was placed the sarcophagus of granite, or calcareous stone, and the mummy, or body. The cell itself was carefully blocked up with rubbish to prevent access to the chamber, and the mouth of it is generally found either in the long axis of the tomb, or else behind the tombstone. The sarcophagus of this period has no resemblance to the later cases in shape of the human form, generally made of wood, which prevailed from the eleventh dynasty, or about 1800 B.C., to the first century, A.D., but are rectangular chests with vaulted cover, with projections at the edges. The bodies found in these chests are distinguished by the absence of linen or wraps in which they may have been embalmed, and bones of the skeleton are only discovered generally, of a brown colour, with a faint odour of bitumen, which is the more remarkable as the mummies found in the pyramid had both linen and indications of bitumen.

Of course, the ethnological question here arises, to what race of men did these old Egyptians of the period of the second and subsequent dynasties belong; they have been referred to the Caucasian races, and some of the skulls show a high intellectual development, even frontal sutures occurring. Their colour is painted in the sculptures, and on their statues, either red or copper, the female yellow, but their profile is not Semitic, and shows, as at the period of their history, traces of African blood. Some of the servants are dolicocephalic, and are supposed to be the indigenous race, similar to the Libyans of Northern Africa, who, however, at a later period, are classed amongst the white races.

It is, however, in vain to look for the origin of Egyptian civilisation, either in Aethiopia or Nubia, or south of Egypt, or on the northern coast of Africa, which lies to the west, for there is no evidence of races in these parts having ever attained a nascent civilisation, such as the Egyptian might have started from. Recent discoveries in Southern Mesopotamia, however, show a similar civilisation, almost, if not as old as the Egyptian, with a form of written language developing from the ideographic to that of the conventional type, into which the original picture invariably declines. The physical type, too, of the Babylonian statues from Tel-lo, approaches the Caucasian rather than the Semitic type.

## ON SOME RECENT AMERICAN MATHEMATICAL TEXT-BOOKS

IN NATURE (vol. xvi. p. 21) we drew attention to a "shaking" that was taking place among the "dry bones" of the mathematical text-books in common use in American colleges and schools, and upon the analysis we then furnished of a few works before us we ventured to predict a speedy awakening of mathematical life. Our prognostications have been quickly fulfilled, and we now propose to submit an account of five recent books, some of which are quite fitted to hold their own, in our opinion, with English text-books on the same subjects.

"The Elements of the Integral Calculus, with a Key to the Solution of Differential Equations," by Dr. W. E. Byerly (Boston, 1881), is a sequel to the volume on the "Differential Calculus," previously noticed by us. This work is founded upon Bertrand's classical treatise, supplemented by free use of the allied treatises by Todhunter, Boole, and Benjamin Peirce. The opening chapters give a clear exposition of the use of symbols of operation and of imaginaries. So early an introduction to these subjects is novel to us in this connection, but it shows how the subject of quaternions is coming to the front, and the passage from the subjects of these chapters to quaternions is but a short one The main portion of the book calls for no special comment. In Chapter XIV. we have a treatment of *mean value and probability*, founded upon the able contributions of Prof. M. W. Crofton, F.R.S., to Mr. Williamson's treatise.

The novelty of the book is Chapter XV., entitled "Key to the Solution of Differential Equations." This key is based upon Boole's work, and is a collection of concise, practical rules for the solution of these equations. An idea of its form will be best conveyed to some persons by saying that it resembles the analytical key so frequently prefixed now-a-days to handbooks of the British (and other) flora. By a series of references we run the particular equation to ground. Thus, taking the example, $(1+x)y\,dx+(1-y)x\,dy=0$, it is a single equation, this sends us to a number; it involves ordinary derivatives, this advances us a stage; it contains two variables, is of the first order, and finally of the first degree. The upshot is we arrive at the form $X\,dx+Y\,dy=0$, under which head we learn how to solve the equation. Under this last head, as throughout the book, are given numerous illustrative exercises for practice.

Dr. A. S. Hardy's "Elements of Quaternions" (Boston, 1881) is intended to meet the wants of beginners. In addition to the works of Sir William R. Hamilton and Prof. Tait, the author has consulted the memoirs or works of Bellavitis ("Calcolo dei Quaternione" and the "Exposition de la Méthode des Équipollences" in Laisant's translation); Hoüel's "Quantités Complexes;" Argand's "Essai" (1806); Laisant's "Applications mécaniques du Calcul des Quaternions," and one or two other books and papers in the *American Journal of Mathematics*, vol. i. p. 379. It is a good introduction to such a work as Prof. Tait's, the originality and conciseness of which, however, Dr. Hardy thinks to be "beyond the time and need of the beginner."

Our next book is "An Elementary Treatise on Mensuration," by G. B. Halsted (Boston, 1881). Dr. Halsted is already known to mathematicians here as the author of a very full "Bibliography of Hyper-space and non-Euclidean Geometry," in the *American Journal of Mathematics*, vol. i., Nos. 3, 4. This treatise on Metrical Geometry is "the outcome of work on the subject while teaching it to large classes," so that it is no hastily prepared book, but has been founded on actual teaching experience. The methods have a German "smell," and this is justified by the author's residence, we presume as a student, at Berlin. There are eight chapters: (1) on the measurement of lines (triangles, method of limits, rectification of the circle; (2) on the measurement of angles; (3) of plane areas; (4) of surfaces (he uses *Mantel* for lateral surfaces, also *Steregon* and *Steradian* in connection with a solid angle); (5) of volumes (*Quader* is new for De Morgan's "right solid"). In these last two chapters the solids discussed are the prism, cylinder, pyramid, cone, and sphere; an article is also devoted to Pappus's theorem. (6) The applicability of the prismoidal formula; (7) approximative methods, as Weddle's method; (8) on the mass-centre, with a paragraph on the mass-centre of an octahedron, which gives Clifford's construction (see *Proc.* Lond. Math. Soc., vol. ix. p. 28). There are numerous exercises, these we have not tested. The book is most effectively "got up," the printing, figures, and paper being, to our mind, excellent.

Our last two books are by Prof. Simon Newcomb, so well known as the author of "Popular Astronomy." The first, "Algebra for Schools and Colleges" (New York, 1881), has already reached its second edition. It is a capital book; indeed we are disposed to rank it as the best manual on the subject that we have seen for school purposes. It is divided into two portions, "the first adapted to well-prepared beginners, and comprising about what is commonly required for admission to colleges, and the second designed for the more advanced general student." We shall perhaps best serve the end we have in view in noticing this work by giving an analysis of the author's preface. The principles of construction are (1) that an idea cannot be fully grasped by the youthful mind unless it is presented in a concrete form. Hence numerical examples of nearly all algebraic operations and theorems are given—so numbers are preferred to literal symbols in many cases. The relations of positive and negative algebraic quantities are represented by lines and directions at the very earliest stage. "Should it appear to any one that we thus detract from the generality of algebraic quantities, it is sufficient to reply that the system is the same which mathematicians use to assist their conceptions of advanced algebra, and without which they would never have been able to grasp the complicated relations of imaginary quantities." Principle (2) is that all mathematical conceptions require time to become engrafted upon the mind, and the longer, the abstruser they are. "It is from a failure to take account of this fact, rather than from any inherent defect in the minds of our youth, that we are to attribute the backward state of mathematical instruction in this country, as compared with the continent of Europe." Prof. Newcomb considers the true method of meeting this difficulty is to adopt the French and German plan of teaching algebra in a broader way, and of introducing the more advanced conceptions at the earliest practicable period in the course. A third feature is the minute subdivision of each subject, and the exercising the pupil on the details before combining them inta a whole. This remark especially applies to the solution of the exercises. Some subjects have been omitted (as G.C.D. of polynomials, square roots of binomial surds, and Sturm's theorem), as they have no application "in the usual course of mathematical study, nor advance the student's conception of algebra," and in studying them there is a waste of power. "Thoroughness" has been our author's aim rather than "multiplicity of subjects." There are other points of interest in this preface which show that the writer is a very experienced teacher, and which we commend to the consideration of teachers here, but we must pass on to indicate the contents of the two parts.

Part I. embraces algebraic language and operations, equations, ratios and proportion, powers and roots, equations (quadratic), progressions, seven books in all.

Part II. treats of relations between algebraic quantities (functions, &c.), the theory of numbers (also continued fractions), the combinatory analysis (including probabilities), series and the doctrine of limits, imaginary quantities (operations with the imaginary unit and the geometrical representation of imaginary quantities: note our remarks above on this head under Byerly), the general theory of equations.

The second of Prof. Newcomb's works before us is "Elements of Geometry" (New York, 1881). An article in our columns (NATURE, vol. xxi. p. 293), headed "The Fundamental Definitions and Propositions of Geometry, with especial Reference to the 'Syllabus' of the Association for the Improvement of Geometrical Teaching," gives its readers a hint that some such work as the one before us was even then in the author's mind—"A summary of my own, the latter [*i.e.* the summary] still in an inchoate state." The remarks in this article showed that their writer was well fitted to address himself to the subject of a geometrical text-book, and the execution is not at all inferior to the promise. The ground taken up is the Euclidian geometry as comprised in the treatises of Euclid himself, Legendre, and Chauvenet. As with the "Algebra," here let Prof. Newcomb speak for himself. As he himself says, the question of the best form of development is one of great interest at the present time among both teachers and thinkers. The object not being to teach geometry merely, but the general training of the powers of thought and expression being a main object, Prof. Newcomb considers it most important to guard against habits of loose thought and incomplete expression to which the pupil is prone. This he considers is best secured by teaching the subject on the old lines. The defects he finds in Euclid's system are (1) in the treatment of angular magnitude; here he makes two additions, the explicit definition of the angle which is equal to the sum of two right angles, and the recognition of the sum of two right angles as itself an angle. He adopts, from the "Syllabus," the term "straight angle," though he himself inclined (NATURE, *loc. cit.*) to the use of "flat angle," and considers the German "gestreckte Winkel" to be more expressive. Then (2) the restriction of the definition of plane figures to portions of a plane surface. "In modern geometry figures are considered from a much more general point of view as forms of any kind, whether made up of points, lines, surfaces, or solids." In an appendix, "Notes on the Fundamental Concepts of Geometry" he returns to a consideration of this subject.

Features of the book are (1) the practising the student in the analysis of geometrical relations by means of the eye before instructing him in formal demonstrations; (2) the application of the symmetric properties of figures in demonstrating the fundamental theorem of parallels (*cf.* German methods and Henrici's conguent figures); (3) the analysis of the problems of construction, to lead the pupil to discover the construction himself by reasoning; (4) the division of each demonstration into separate numbered steps, and the statement of each conclusion, where practicable, as a relation between magnitudes; (5) the theorems for exercise have been selected with a view to interesting the student in the study, and the author has endeavoured to graduate them in order of difficulty; (6) some of the first principles of conic sections have been unfolded, more especially for the use of students who do not propose to study analytical treatises on those curves; (7) Euclid's treatment of proportion is "perfectly rigorous, but has the great disadvantages of intolerable prolixity, unfamiliar conceptions, and the non-use of numbers. The system common in American works of treating the subject merely as the algebra of fractions, has the advantage of ease and simplicity." But to this last system there are obvious objections, and our author essays with some reserve, a *via media.* In this part and in the following Prof. Newcomb submits his methods to the judgment of teachers. Feature (8) involves the treatment of the fundamental relations of lines and planes in space. "In presenting it he has been led to follow more closely the line of thought in Euclid than that in modern works. At the same time he is not fully satisfied with his treatment, and conceives that improvements are yet to be made."

It will be gathered that the book covers most of the ground passed over by young students in plane and solid geometry, and conics in their school training. We cordially commend both Prof. Newcomb's works to teachers in this country, and we feel sure they will not regret our having called their attention to them so fully in the author's own words, as they will thus see in what way his books are likely to be helpful to them. We have read them with much interest, and feel sure our readers will endorse our favourable verdict upon them. We need only say that the author considers that the study of geometry as here unfolded can be advantageously commenced at the age of twelve or thirteen years. The volumes, with a third, which we have not seen, on Astronomy, form part of "Newcomb's Mathematical Course."

R. TUCKER

## *ELECTRICITY AT THE CRYSTAL PALACE*

### IV.—*Submarine Telegraphy*

IN the stall of the South Eastern Railway Company at the Crystal Palace may be seen a specimen of the first cable core ever submerged. It consists of a slender copper wire coated with gutta-percha, and was prepared at Streatham by Mr. J. Forster. On January 10, 1849, it was submerged by Mr. Walker, at Folkestone, and a copy of the telegram announcing the completion of the work is still preserved. It runs: "I am on board the *Princess Clementine.* I am successful; 12.49 p.m." Next year a cable was laid between Dover and Cape Grisnez by Mr. Wollaston, but lasted only a few hours. Several specimens of it are shown in the Exhibition by the South Eastern Railway Company and the Post Office. The gutta-percha core was quite unprotected, and it was sunk by means of lead weights attached at intervals. Next year a core, protected by hemp and iron sheathing, was laid by Mr. T. R. Crampton between Dover and Cape Grisnez, and proved so successful, that it is still working. Specimens of this cable, which has proved the type of all subsequent ones, are also to be seen.

There are now some 97,200 miles of cable at work in the world, and before this year is ended the hundred thousand miles will have been attained; for the second Jay Gould Atlantic cable is still unfinished, and the s.s. *Silvertown* of the India-rubber and Gutta-percha Telegraph Company is now on her way to lay some two thousand miles on the West Coast of Central America. Nearly all this cable has been made in London, and the Telegraph Construction and Maintenance Company alone has manufactured 65,400 miles, and laid it in almost every sea, in depths varying from shoal water to 3000 fathoms. In 1863 the firm was resolved into the existing Company. Specimens of all the cables made by them are exhibited in a large glass case, together with a large map of the world, showing all the submarine and land lines in existence; those constructed by the Company being marked in red. The most novel feature of their exhibit is, however, a plan for keeping up telegraphic communication between a lightship and the shore. In 1870 an attempt was made to establish a floating telegraph station in the chops of the Channel; an old man-of-war corvette, the *Brisk*, being fitted up, and moored in deep water about sixty miles from the Land's End. It was found, however, that as the ship swung with the tide, the telegraph cable fouled with the ship's riding-chain, and likewise became twisted into kinks, which crushed the gutta-percha core and destroyed the insulation of the cable. Means were taken to prevent this trouble, but as passing ships did not leave a sufficient number of telegrams, the project was abandoned. Nevertheless, it is clear that such a scheme is worthy of further trial; and even with ordinary lightships it is eminently desirable that they should be in telegraphic communication with the nearest Coast Guard Station. At present, guns and rockets are the only available messengers, and when the wind is off the shore, guns are sometimes not heard; or when the weather is thick, rockets are not seen. The result is, that ships are sometimes lost on shoals close by the lightships, without the Lifeboat Station knowing it. Carrier-pigeons have been tried, but these birds fail to make good progress in snow-storms or thick weather, and in heavy gales are driven hither and thither at the mercy of the elements. The plan for cable communication adopted by the Telegraph Construction and Maintenance Company is to moor the lightships by chains to two mushroom anchors sunk a considerable distance apart. One of these chains is made double, and the cable runs through the middle of it between the double links, as shown in Fig. 1. The chains meet at a mooring swivel, which is made so as to allow the cable to pass through it, as shown in Fig. 2. Between the swivel and the bow sheave of the ship, a revolving joint in the cable, designed by Mr. Lucas, prevents the cable becoming twisted as the ship swings to the wind and tides. A sufficient length of cable is coiled in a tank on board, for paying out, when from stress of weather it is necessary to employ more chain. A pretty model of a lightship moored on this plan is exhibited by the Company, and on touching a press-button let into the edge of the tank, an electric current is sent through the communicating cable, and strikes a bell on board the ship. It is satisfactory to know that the Trinity House have agreed to test the plan by means of a cable between the *Sunk* lightship moored some eight miles off the Essex coast, and the Post Office of Walton-on-the-Naze, from whence telegrams can be sent by day or night for any assistance required.

Of the total 97,200 miles of cable in the world, some 36,420 are owned and worked by the Eastern Telegraph Company and its affiliated companies the Eastern Extension Telegraph Company and the South African Telegraph Company. The Eastern Telegraph Company is perhaps the most enterprising of cable corporations, and makes a very fine display at the Crystal Palace. Cable operations have been of great assistance to the geographer, and the soundings taken in order to ascertain the nature of the sea-bottom, where a cable route is projected, have enriched our charts quite as much as special voyages. There is, however, another way in which these operations could be made subservient to the cause of natural science; but it is a way which has not been sufficiently taken advantage of. Besides the specimens of stones, mud, and sand, which the sounding-lead brings up from the deep, the cable itself, when hauled up for repairs, after a period of submergence, is frequently swarming with the live inhabitants of the sea-floor—crabs, corals, snakes, molluscs, and fifty other species—as well as overgrown with the weeds and mosses of the bottom. Some attempt was made to describe these captures of the wire, as taken from the tepid seas of the Amazon mouth, by the writer in our pages several years ago (vol. xi. p. 329),[1] and the suggestion was there made that cable repairing might serve as a novel method of dredging; but the hint has probably not been taken, for we cannot learn of any competent naturalist having taken his passage on board a cable-repairing ship, say in the Brazilian and West Indian waters, or better still, the East Indian waters traversed, by the lines of the Eastern and Eastern Extension Telegraph Company, from Aden to Bombay, and from Madras to Penang, Singapore, Batavia, and soon to Port Darwin, in Australia. The result is that cables have again and again been lifted richly vestured with the spoils of the bottom, and many an unknown species has passed over the drums unnoted, to rot and fester in the general mess within the cable tanks. We venture to predict a rare harvest to the first naturalist who will accompany a repairing ship, and provide himself with means to bottle up the specimens which cling to the cable as it is pulled up from the sea.

Some idea of these trophies may be gathered from the stall of the Eastern Telegraph Company, where a few of them are preserved. Two of these are a very fine grey sea-snake, caught on the Saigon cable in a depth of thirty fathoms, and a black and white brindled snake, taken from the Batavian cable in twenty-five fathoms. Twisting round ropes seems to be a habit of this creature, for the writer remembers seeing one scale up a ship's side out in the River Amazon, by the "painter" hanging in the water.

A good example of a feather-star is also shown; these animals, being frequently found grasping the cable by their

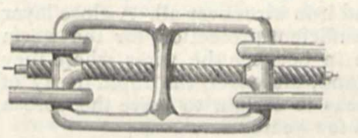


Fig. 1.

Fig. 2.

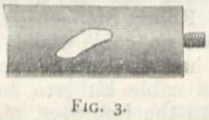


Fig. 3.

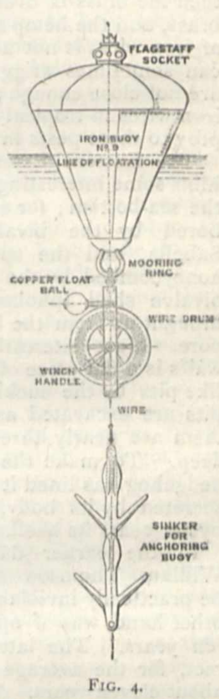



Fig. 4.

tentacles. A handsome specimen of the blanket sponge, picked up in the Bay of Biscay, is also exhibited; but the most interesting object of all is a short piece of cable so beautifully encrusted with shells, serpulæ, and corals, as to be quite invisible. It was picked up and cut out in this condition from one of the Singapore cables. The rapid growth of these corals is surprising, and some valuable information on this head might be gained if the electricians of repairing ships in these eastern waters would only make some simple observations. Curiously enough, so long as the outermost layer of oakum and tar keeps entire, very few shells collect upon the cable, but when the iron wires are laid bare, the incrustation speedily begins, perhaps because a better foothold is afforded.

A deadly enemy to the cable, in the shape of a large boring worm, exists in these Indian seas; and several of them are shown by the Company. The worm is flesh-coloured and slender, of a length from 1½ inches to 2½ inches. The head is provided with two cutting tools, of a curving shape, and it speedily eats its way through the hemp of the sheathing, to the gutta-percha of the core, into which it bores a hole similar to that shown in Fig. 3.

[1] "On some South American Phenomena" (J. Munro).

A full account of this particular worm, with anatomical illustrations, is given in the *Journal* of the Royal Microscopical Society for October, 1881, by Dr. Charles Stewart, secretary of the Society. The bore-holes, after passing through the oakum of the inner sheathing, either pursue a tortuous course along the surface of the gutta-percha core, or go right into the copper wire, thereby causing a "dead earth" fault. Dr. Stewart classes the worm as one of the Eunicidæ, but proposes for it the generic name of *Lithognatha worslei*, because of its possessing a pair of calcareous mandibles or cutting jaws, and after Capt. Worsley, the Commander of the repairing ship which picked up the worm-eaten cable. The pair of calcareous jaws, in addition to three pairs of chitinous ones, is the most remarkable feature about the animal, and the white plates which form them make the creature look as if it were in the act of swallowing a tiny bivalve shell.

The best protection hitherto formed against it is to cover the core with a ribbon of sheet-brass, laid on without a lap. First the gutta-percha is covered with cloth, then the brass is overlaid. Canvas is then put over the brass, and the hemp and iron wires over all. A close layer of iron wires is not a sufficient protection, for the worm can sometimes wriggle in between the wires where they are not close enough; and, moreover, the rapid decay of iron wires in tropical seas is certain to leave the core a prey to these pests in a few years.

The Eastern Extension Telegraph Company also exhibit some interesting samples of stones picked up from the sea-bottom; for example, limestone blocks and shells bored by the bivalve, *Saxicava ragosa*, the worm Sabella, and the sponge *Hymeniacidon celata*; wood honeycombed by the teredo, a red stone pitted by the bivalve shell (pholas), and a ferruginous flaky stone brought up from the bottom between Penang and Singapore. Most interesting, however, of these inanimate waifs is a flat piece of black flinty rock hollowed into cup-like pits by the sucking feet of the sea-hedgehog. The pits are excavated as lairs for the animal and some of them are nearly three inches in diameter by one inch deep. To make the rocky bed softer to the feel, the hedgehog has lined it with a calcareous enamel, probably secreted by its body, much in the same way as the pearl oyster coats its shell.

In the earlier days of submarine telegraphy, Sir William Thomson declared the life of a cable to be practically inviolable; and Robert Stephenson, on the other hand, was of opinion that no cable would last out ten years. The latter view has proved the more correct, for the average life of a cable hitherto has been about eleven years. Thanks to the improved means of repairing them, however, the outbreak of faults does not mean the loss of a cable, for these flaws can be cut out in water, however deep, and the cable put to rights again. Indeed every cable company expects a recurrence of faults, and provides a fully-equipped repairing ship always on the spot. A fine model of such a ship is exhibited by the Post Office, after the designs of Mr. R. S. Culley. Messrs. Johnson and Phillips also exhibit a variety of buoys and grapnels for cable operations. The ordinary grapnel is liable to have its prongs broken off in dragging over a rocky bottom, as may be seen from one exhibited which had every prong bent back among the coral reefs of the Brazilian coast. Centipede grapnels are therefore fitted with removable prongs; and Mr. A. Jamieson has invented a grapnel with spring teeth which bend back when they meet a rock, so as to slip over it, but catch and hold the cable. A sample of this grapnel is shown in the Western Gallery, and a sample of Messrs. Johnson and Phillips' grapnel for cutting the cable and holding one end is shown in front of the Roman court, together with a very large buoy for buoying the cable in deep water. A very convenient and novel "mark" buoy for marking positions in cable work is exhibited by the same firm in the Western Gallery. The buoy is suspended by a line from the ship's quarter or stern, and when the line is cut, the buoy drops into the water. The copper float ball (see Fig. 4) is then raised, and lifts a detent which allows the drum of steel wire to revolve. The centipede anchor then sinks to the bottom, and moors the buoy. A winch handle is provided, so that the moorings can be recovered if need be, but the cost of the sinker, drum, and wire is so slight that it may readily be abandoned. While upon the subject of deep-sea operations, we may also mention the "nipper lead" of Mr. Lucas, by which specimens of the sea-bottom are caught in two spoons or tongs hinged to the bottom of the lead, and kept apart by a trigger arrangement, which is sprung by the lead striking the bottom.

Coming now to the working of submarine cables, there are several very neat mirror galvanometers exhibited by Messrs. Latimer Clark, Muirhead, and Co. The Eastern Telegraph Company exhibit the siphon recorder of Sir William Thomson, working through one of Dr. Muirhead's artificial cables on the duplex system, the counter instrument being placed at the stall of the School of Telegraphy. The bold electromagnets of this fine instrument have been excited hitherto by Sir W. Thomson's large tray-form of Daniell cell; but quite recently Mr. Clement Chevallier, electrician to the Eastern Telegraph Company at Aden, has substituted permanent magnets, with a great gain in economy. These magnets were specially made by Mr. Le Neve Foster, at Silvertown, and their magnetic power is much heightened by a small percentage of tungsten in the steel. An interesting experiment, showing the retardation of signals through a long submarine cable, is made by the School of Telegraphy. Ten mirror galvanometers, throwing ten light-spots in a vertical row on a white screen, are connected in turn at different points of a long cable, and the travel of the charge when the circuit is closed by a key is shown by the successive movements of the light-spots across the screen.

Mr. C. F. Varley, F.R.S., who by his application of condensers to the submarine circuit did so much to improve cable signalling, has a very interesting exhibit of his past inventions. These include his gravity battery patented in 1854 (No. 2555), and repatented in 1861 by Menotti, whose name it bears. In the same patent the sulphate of mercury battery, subsequently known as the Mariè-Davy, was also described. This patent, like most of Mr. Varley's, was very rich in devices, and contains his application of the condenser not only to telegraphy, but to electric lighting, a plan subsequently patented by Jablochkoff. Mr. Varley's exhibit also includes the first polarised relay used in this country, and the rotary electrical machine made and patented in 1860, and held by him to be the parent of the Holtz and other induction machines, such as the mousemill of the siphon recorder and the replenisher of the quadrant electrometer. But it is probable that Mr. Varley's claim must give way in favour of M. Belli, who invented a similar induction machine many years ago, which the writer saw in the Retrospective Museum of the recent Paris Electrical Exhibition.

## THE EARLIEST USE OF THE INCANDESCENT ELECTRIC LIGHT

A CORRESPONDENT writes:—

The following extract from a memoir by Sir William Grove, published more than thirty-six years ago, will be of interest to future historians of the progress of lighting by electricity. The memoir is entitled "On the Application of Voltaic Ignition to Lighting Mines," by W. R. Grove, F.R.S., and is published in the *Philosophical Magazine*, May, 1845. It begins by stating that M. De la Rive had proposed the use of the voltaic arc for illuminating mines; it describes the apparatus employed by him, and the difficulties that prevented its practical application, and continues as follows:—

"I substituted the voltaic ignition of a platina wire for the disruptive discharge. Any one who has seen the common lecture-table experiment of igniting a platina wire by the voltaic current nearly to the point of fusion, will have no doubt of the brilliancy of the light emitted; although inferior to that of the voltaic arc, yet it is too intense for the naked eye to support, and amply sufficient for the miner to work by. My plan was then to ignite a coil of platinum wire as near to the point of fusion as was practicable, in a closed vessel of atmospheric air, or other gas, and the following was one of the apparatus which I used for this purpose, and by the light of which I have experimented and read for hours:—A coil of platinum wire is attached to two copper wires, the lower parts of which, or those most distant from the platinum, are well varnished; these are fixed erect in a glass of distilled water, and another cylindrical glass closed at the upper end is inverted over them, so that its open mouth rests on the bottom of the former glass; the projecting ends of the copper wires are connected with a voltaic battery (two or three pairs of the nitric acid combination), and the ignited wire now gives a steady light, which continues without any alteration or inconvenience as long as the battery continues constant, the length of time being of course dependent upon the quantity of the electrolyte in the battery cells. Instead of making the wires pass through water, they may be fixed to metallic cups well-luted to the necks of a glass globe.

The spirals of the helix should be as nearly approximated as possible, as each aids by its heat that of its neighbour, or rather diminishes the cooling effect of the gaseous atmosphere; the wire should not be too fine, as it would not then become fully ignited; nor too large, as it would not offer sufficient resistance, and would consume too rapidly the battery constituents; for the same reason, *i.e.* increased resistance, it should be as long as the battery is capable of igniting to a full incandescence."

The memoir concludes with the description of experiments on the illumination power of this contrivance under different conditions.

## *THE ENGLISH ECLIPSE EXPEDITION*

THE following communication, under date lat. N. 37·8, long. E. 11·10, April 27, has appeared in the *Daily News*, from the special correspondent of that paper with the English Eclipse Expedition:—

Your correspondent so far has not had a very easy time of it, although it must be confessed his difficulties have been in no way connected with lack of material. Chronicling attempts to advance beyond the frontiers of the known must always be a pleasant task to the chronicler, who is thus enabled to be among the first to reap the rich intellectual rewards always gained, or nearly always gained, in such forays. But when the task brings him in full view of other interests, and especially when it compels him to observe phenomena for himself, a correspondent's task may become complicated beyond measure, and not only the *embarras de richesses*, but even a mental revision of his instructions, however precise they may have been, may give him trouble. Thus, in the present case, my clear duty is to keep pace with the thoughts and doings of the Eclipse party now on the *Kaisar-i-Hind*, between Gibraltar and Malta; but am I therefore to be blind to the fact that each P. and O. ship does not leave Gravesend with two tons of telescopes and eyes to use them, and that the infusion of a scientific party into the general run of passengers on this the most important of England's seaways, cannot but cause what our American cousins would call a "ripple" on the ordinary routine of ship-life.

Those who have made their way to the far East many times, and who are therefore quite familiar with this routine, will at once recognise the possibility that at first such *raræ aves* were looked at askance. Was there not at least some strange power of divining secrets in sextants, spectroscopes, and cameras brought now and then, and with a kind of furtive air, from hidden recesses? And this being so, what conduct was more natural on the part of the non-scientific members of the party, than that they should show a keen anxiety to assure everybody that they at least knew next to nothing of science—in short, that though they might deplore these strange and aberrant tendencies, they were powerless to interfere, even if the studies were less harmless than they believed them to be. This, at first, of course confirmed the general impression, but it did not take long for the ice to melt; the strange feeling soon wore off, and after a fierce gale which the *Kaisar-i-Hind* encountered in the Bay of Biscay had abated, the keenness of everybody on board to hear something of a world of marvels new to most of them, and the anxiety of every servant of the P. and O. Company, from captain to boatswain, to help, whenever help was needed, were the predominant features.

The delight of the Somali boys at being photographed was a sight to see, their broad grins being in strange contrast with the evident anxiety of the Arabs among the crew to escape the influence of such a possible evil eye. While this is going on in one part of the ship, the reflection of the summer sun shimmering from a thousand Mediterranean waves through which the noble ship ploughs her way on an even keel is utilised to show the wondrous work which has already been done by the spectroscope. Nor are the other worlds, still left to conquer, forgotten in the demonstration; among them, those secrets of the Sun which it is hoped may be unveiled during the coming precious seventy seconds. And this brings me to the proper subject matter of the present letter. What, then, are the astronomers going to do? or, to put it more modestly, what are they going to try to do? Before a categorical answer can be given to this question there is some preliminary matter to be got over; we have, in fact, to consider the changes in thought and methods introduced by ten years of work. A volume might be written on this, but a very brief *exposé* is really all that is required on the present occasion. The brilliant achievements of physical astronomers in the domain of solar physics during the last twenty years have dealt in the main with the chemical and physical construction of the atmosphere of our central luminary; that is, those parts of it which are furthest from the centre. In fact, it has been a question of meteorology, and not a question of geology, to use terrestrial equivalents. One of the first things made absolutely certain was that the outer atmosphere for tens and perhaps hundreds of thousands of miles above the surface of the round orb we generally see and call the Sun, is intensely hot—hot enough to have its clouds built up of vapour of iron, as in our own air we have clouds built up of the vapour of water. Next, as the work went on, two things happened. First, certain and sure evidence was obtained that the outer atmosphere extended much farther from the sun than had been previously supposed by those most competent to form a just opinion; and, further, while the extent of the atmosphere was thus engaging attention, the chemical inquiry had been carried so far that we thought we were justified in saying, not only that the sun's atmosphere contained just such substances as ours would do if our little earth were suddenly turned into a mass of vapour, but that certain substances occupied such and such positions in the atmosphere, while others were to be sought for elsewhere.

Thus outside all, it was imagined, there was a substance about which we know nothing here, because we cannot find anything which produces the same spectrum. Inside this, at mid-height in the sun's atmosphere, we got indications about which there could be no mistake—we were in presence of hydrogen: incandescent hydrogen, be it observed, which plays as important, or indeed a still more important part in the solar air than nitrogen does in our own. Next it was imagined that close to the sun itself there was a vaporous sea containing all the other substances which had been detected by the spectroscope—magnesium, calcium, iron, barium, cobalt, nickel, and some twenty other bodies termed "elements" by the chemist, because he cannot reduce them to a condition of greater simplicity. As the sum total of these inquiries, then, we had some such idea of the sun's atmosphere as this: Physically it was incandescent, of enormous extent, very irregular in outline, its extent and outline varying almost every time it could be observed. Chemically it was built up of substances known to terrestrial chemistry; it was very simple at top, and very complicated at bottom. This mental image was the joint product of both laboratory and eclipse work. The solar spectrum—that is, the beautiful rainbow ribbon which is produced when light from the sun is made to pass through a prism—enabled us even in our laboratories, without a telescope, to study the chemistry of the sun's atmosphere as a whole, but such work as this localised nothing. Further, the outer atmosphere is so dim as compared with the intensely brilliant interior nucleus, that it, like the stars in the day-time, is put out, and remains invisible so long as the sun itself is in a position to illuminate our upper air. In this we have the use of total eclipses, for at such times the moon prevents the sunlight from falling on our atmosphere, and the sun's atmosphere shines out in all its weird splendour, as the stars show themselves when the light of day is withdrawn. It is fair to add, that there is a method which enables us to study the chemistry and even the meteorology of the very brightest portion of the sun's atmosphere, called the chromosphere, without waiting for an eclipse, but still, every allowance being made, it should be now clear that to study the physical attributes of the atmosphere as a whole, we are strictly limited to total eclipses. So much, then, for our brief *exposé*. There is still some more ground to be gone over before the question with which we set out is answered. What was the sum total of the work done during the last eclipse—that observed in the United States in 1878, with a wealth of instrumental appliances such as had never been used before? How did it deal with our received notions? Did it endorse them or demolish them?

It certainly endorsed them in the main, while it enabled us to accumulate a vast amount of new knowledge on many important points, and showed us how every effort should be made to secure these precious records. Among other things, it intensified the difference between eclipse and eclipse, for the spectroscopic record of the outer corona—as the exterior atmosphere is sometimes called—differed very considerably from the one secured in 1871, and it was a noteworthy fact that the eclipse of 1871 happened when there were most spots on the sun, while that of 1878 took place when there were fewest. I said "in the main." But during the eclipse one observation was made, which in the light of former laboratory work suggested that after all there was a rift in the lute, and that our view of the solar economy might be much more wrong than we had any idea of. Since 1878 that same laboratory work has been continued, and a long series of observations of the spectra of sun-spots has been made, and the tendency of all this extra eclipse-work has all been in one direction. We are now face to face with the idea that, in the hottest part of the sun, the temperature is so high that our so-called elementary bodies are broken up into simpler ones, and that the reason that the sun seems to contain so many of our terrestrial elements is simply that both in the sun and in a powerful electric spark these bodies are really broken up into their finer constituents, the spectral lines of these finer constituents being observed in both cases. Now it is obviously the duty of men of science, if there be any tests of this new view, any crucial observations possible during an eclipse, to apply these tests, to make these observations, as soon as possible—not, of course, to the neglect of the old methods of attack, but, if possible, in addition to them; and as the problem is one of such general interest, and one which is sure to be keenly debated, as many records independent of personal error or personal bias should be obtained as possible. These permanent records, to which reference has been made, are of course photographs, and here we are brought face to face with another fact; we have not only a new view to test, but we have new photographic processes to apply to test it, as well as to obtain a series of records comparable with those secured during prior eclipses. We have in this case an instance of the way in which an observation, apparently trivial, is at last seized hold of and made to furnish a stepping-stone for a further advance in scientific inquiry. It is now many years since Faraday, experimenting on gold leaf, which is green when a bright light is observed through it, found that he could change its colour, and he fancied that this might be taken to indicate that the gold in the leaf did not consist of particles all of the same size, but that they existed of almost an infinite series of finenesses. This was in the pre-spectroscopic days. When the spectroscope could be brought to bear, it became apparent that two orders of fineness only were required to produce all the colours observed by Faraday, and Mr. Lockyer soon produced other evidence which went to show that we were here in presence of a general law. From this time we heard the words "blue molecules" and "red molecules"—terms invented to indicate that in the same chemical substances there were some molecules with such physical attributes that they were turned to and could therefore absorb blue light, while others were made active by red light falling upon them.

Capt. Abney, in a series of painstaking researches, has shown that precisely those salts of silver employed by photographers obey this general law, and hence we can now use blue light and red light indiscriminately, and so, for the first time we can photograph the red end of the spectrum of the sun's external atmosphere. Nor is this all; other advances in the photographic art enable us now to replace minutes by seconds in the time of exposure; indeed, in these days of "instantaneous" processes, the difficulty often lies in exposing the plate for a time short enough to the influence of the light. It is as well to insist upon this point, as in the eclipse of next month the totality or period during which the moon entirely covers the sun is very short; but short as it is, it is more than made up for by the increased rapidity of the processes to be employed. Now, the most important phenomena to be recorded, whether by eye or photography, are, first, the spectrum of the lowest stratum of the sun's atmosphere revealed to us at the moment of disappearance and reappearance of the sun by a sudden flashing out of bright lines; next, the spectrum of the outer atmosphere, best observable at mid-eclipse; and then the extent and structure of the atmosphere itself. Now it is imagined, that if the new view to which reference has been made is correct, the spectrum of the lower stratum will differ from what it is supposed to be, and we say supposed to be, because up to the present time the observations have been of such a general nature that it has been impossible to be quite certain about details. The intention this time is to observe a small portion of the spectrum with great minuteness, so far as the eye observations go, while an attempt will be made to actually photograph the flash of bright lines, and obtain a reference spectrum afterwards by obtaining a photograph of the solar spectrum on the same plate after the eclipse is over.

Among the most interesting observations made during the total eclipse of 1878—duly chronicled in the *Daily News* at the time—was one by which Prof. Newcomb demonstrated a tremendous extension of the corona in the direction of the plane of the sun's equator, or very near it. It will be important to see, whether on the present occasion the extension will be so great, especially since Dr. Siemens has thrown down the gauntlet to astronomers by his bold speculations touching the circulation of the solar gases. Such, then, are some of the things which the Eclipse Expedition is going to do, or going to try to do. If all goes well, I shall be able in my next letter to tell your readers something of a definite nature as to the actual camping-ground and the local arrangements in Egypt.

The following telegram from its special correspondent is given in Tuesday's *Daily News*:—

*Sohag, Monday*

The preparations are complete for the eclipse on Wednesday, thanks to the assistance rendered by the representatives of the Egyptian Government to the English, French, and Italian observers alike. The weather is apparently settled. There is little probability of dust-storms. The greatest heat experienced is 108 in the shade. The temperature is now cooler. The English party will probably return by Carthage, leaving Suez on the 31st.

## *ALGÆ*[1]

It is little more than a year since the Latin edition of Dr. Agardh's work on the "Morphology of the Florideæ" was noticed in the pages of NATURE. The author now sends us another contribution to the systematical study of algæ. The present is, however, not a distinct work, but a continuation of a series of Essays or Monographs, the first instalment of which appeared in vol. ix. of the *Transactions* of the University of Lund, in the year 1872. The subjects of the first instalment were the genera Caulerpa and Zonaria, and the classification and description of the Australian species of certain tribes of Sargassum.

The present work consists of essays on the CHORDARIEÆ, and on some of the DICTYOTEÆ. Although it bears a Swedish title, it is written in Latin. It commences with a monograph of the family Chordarieæ, which is entirely reconstructed, and is enlarged by the introduction of several new genera. Under the present arrangement it comprises seventeen genera.

From the increased activity recently shown by British algologists, whose exertions have been rewarded by the discovery of many species of Algæ new to these shores, it would seem desirable to mention more particularly a few of the changes which have been made in the present work by Dr. Agardh in the classification of some of the plants of the olive series of Algæ.

Beginning with Elachistea, as the author, restoring the old spelling, prefers to call it, we find that this genus is removed to the CHORDARIEÆ. This is in accordance with the views of Dr. W. H. Harvey, expressed in the "Phyc. Brit. Tit." *E. fucicola*. This genus is especially interesting from the fact that out of the nine species, seven are British. *E. velutina* (of the "Phyc. Brit." pl. xxviii. B), removed by Thuret to Streblonema, is placed by Dr. Agardh in his new genus Herponema (see p. 55).

The next genus, Myriocladia, includes *M. Loveni*, an extremely rare species, which has been obtained growing on oysters in deep water in the Baltic, and which Dr. Agardh ("Sp. Alg.", p. 53) states was found by the late Mr. Borrer on the Sussex coast; it has not, however, been met with by succeeding observers; neither has Dr. Agardh seen the plant in other collections. The name of this rare plant does not occur in the published lists of Algæ found by Mr. Borrer. A representation, much enlarged, of some of the details of the plant, will be found on Pl. 1, Fig. 3.

The genus Mesogloia is now restricted to two species, *M. Mediterranea* and *M. vermicularis*. *M. virescens* is removed to Eudesme, of which another species inhabits Tasmania and South Australia. *Chordaria divaricata* and *Mesogloia Griffithsiana* are now respectively *Castagnea divaricata* and *C. Griffithsiana*. The observations on the structure and fruit of the epiphytic plants, which constitute the genera Myrionema and Herponema, will be interesting to British algologists.

Among the new Algæ which have been recently added to the British Marine Flora, is the handsome plant found by Mr. G. W. Traill, in the Firth of Forth, and issued to British collectors under the name of *Dictyosiphon Hippuroides*. The plant was first described and figured by Lyngbye in the "Hydrophytologiæ Danicæ," under the name of *Scytosiphon Hippuroides;* then, in Agardh's "Sp. Gen. et ord. Alg.", vol. i. p. 66, as *Chordaria flagelliformis*, var. *B. Hippuroides*. Areschoug subsequently distributed dried specimens of the plant, and published (*Bot. Notiser*, 1873, No. 6., and *Obs. Phycol.*, iii. 1875) descriptions of it under the name of *Dictyosiphon Hippuroides*. In the present work Dr. Agardh maintains the opinion he had expressed in 'Sp. Alg." more than thirty-three years ago, that the *Scyt. hippuroides* of Lyngbye is a form of *Chord. flagelliformis*, and not a Dictyosiphon. He supports his views by a minute description of the structure of the frond, and gives at length (pp. 67-70) his reasons for differing in opinion from his old friend Dr. Areschong. As a proof of the care with which Dr. Agardh conducted his examination of the plant, it may be mentioned that he describes and names six forms of it, including among them, *Scyt. Hippuroides*, Ll., and *Scyt. tomentosus* of Fl. Dan. and Lyngb. British algologists will find this part of Dr. Agardh's work particularly interesting.

Among the Algæ which have been recently added to the British Marine flora are *Phlæospora tortilis* (Rupr.) Aresc., and *Dict.* (*Coilonema*) *mesogloia*, Aresc.; it may be mentioned incidentally that Dr. Agardh considers both Phlæospora and Coilonema as distinct genera.

The DICTYOTEÆ.—The author commences with preliminary remarks on the limits of the family, and the structure and fructification of the different genera (pp. 77-83). Then follows an elaborate essay on the genus Dictyota (pp. 83-92); and after that a description of the species, and the tribes under which they are arranged. Of the twenty-six species, one only, *D. dichotoma*, is a native of our shores. Six other species are referred to Dilophus, J. Ag., and two to Glossophora, J. Ag.

The genus Spatoglossum, Kg., includes *Taonia Solierii*, *T. Schrœderi*, and two others. Then follow a few observations on *Taonia atomaria*. Padina is treated at greater length. To this succeed elaborate observations on the structure and fructification of Zonaria (pp. 120-131), and some remarks on certain species. This part of the work, it must be observed, is supplementary to the article on Zonaria in the first part of the "Bidrag," p. 45, before referred to, in which the several species are described.

It may here be remarked that the *Zonaria collaris* of the "Phyc. Brit." has no claim to be considered as a native of the British Isles. It is found in the Mediterranean and Adriatic, and occasionally in Granville Bay, on the French coast. It is not a Zonaria, but a Cutleria.

The work concludes with some observations on the species of Halyseris.

In the selection of the preceding subjects for remark, the writer has been guided by the interest which, it was thought, would be taken in them by British algologists; it must, however, be observed that the work has also many points of interest as regards Australia, Tasmania, and New Zealand. Among the species belonging to the

[1] Til Algernes Systematik. Nya bidrag af J. G. Agardh (Andra Afdelningen). Lunds Univ. Årsskrift. Tom. xvii. (4to., pp. 134).

CHORDARIEÆ, sixteen are natives of these colonies; while in Dictyota, Dilophus, and Glossophora, which, together contain thirty-four species, no fewer than fifteen belong to the same localities.

It is almost superfluous to say that the work in every part gives evidence of the careful and patient observation which characterise all the writings of Dr. Agardh, and render them so valuable an aid to the study of algology. It is to be hoped that before long we may have the pleasure of welcoming another instalment of his contributions to the study and classification of the Melanosperms.

M. P. M.

## NOTES

THIS week we give the first of a short series of articles on the life and work of the late Mr. Darwin. The series is under the general care of Dr. G. J. Romanes, F.R.S., who also will take special charge of the Zoology and Psychology. The Geology will be by Prof. Geikie, F.R.S., Director of the Geological Survey, and the Botany by Mr. W. T. Thiselton Dyer, F.R.S.

THE first meeting of the Executive Committee of the Darwin Memorial was held in the rooms of the Royal Society on Tuesday, May 16, at which it was resolved that subscriptions be invited in order to promote such a memorial of the late Mr. Darwin as shall seem most fitting, having regard to the amount that may be collected. Subscriptions will be received by Mr. J. Evans, Treasurer, Royal Society, Burlington House, W.

AT a meeting of Convocation of the University of London held May 9, the following resolution was unanimously passed :—"The Graduates of the University of London, in Convocation assembled, desire to record their sense of the irreparable loss which science and philosophy have sustained in the death of Mr. Darwin, whom they recognise as an acute and patient investigator, an earnest seeker after truth, and an original thinker, whose discoveries have exercised a profound influence upon scientific research and upon the progress of scientific thought throughout the world."

A NOVEL feature at the meeting of Convocation of London University, last week, was the appearance for the first time of female graduates in academical costume. Sir George Jessel, who presided, gave some statistics to show the rapid progress in the numbers availing themselves of the University's examinations, while Sir John Lubbock pointed out the progress that had been made in scientific education during the past year, referring especially to the City Technical Institute. "What is wanted," he said, "is not so much money or men, as method and organisation, and to utilise the resources we already possess." He referred to the wasted resources of Gresham College, which, he said, ought to be "placed on a footing more in accordance than it has been with the wise designs of its noble founder." It was agreed to request the Senate to take definite steps with regard to this fossilised institution.

A WELL-DESERVED baronetcy has been conferred upon the eminent scientific agriculturist, Dr. John Bennet Lawes, F.R.S. The vast services rendered to agriculture by Sir John B. Lawes, in connection with Dr. Gilbert, are well-known. The new baronet, we learn from the *Times*, was born in 1814, and succeeded to his estate at Rothamstad, in Hertfordshire, in 1822. Mr. Lawes was educated at Eton and at Brasenose College, Oxford, where he remained from 1832 to 1835. During his academic career he displayed at once a strong partiality for the laboratory, and on leaving the University, spent some time in London, for the purpose of studying in a practical manner the science of chemistry. Possessed of independent means, a handsome property, and a beautiful old manor-house and demesne, Mr. Lawes at once interested himself in agriculture. In October, 1834, he first commenced regular experiments in agricultural chemistry on taking possession of his property and home at Rothamstead, and from that date up to the present time Mr. Lawes has unceasingly been applying his scientific knowledge to the solution of questions affecting practical agriculture. Sir John Lawes, we believe, has not only entirely maintained his experimental farm of 500 acres, but has further set apart a sum of 100,000*l*. and certain lands for the convenience of the undergraduates after his death. This is indeed a gift to the nation, a gift, too, which no money value adequately represents.

MR. F. V. DICKINS, M.B., B.Sc., has been appointed Assistant Registrar to the University of London, in succession to Prof. Moseley.

THE second meeting of the Bohemian Naturalists and Physicians will take place at Prague during May 24-30, to celebrate the foundation of a Slav University in that city.

M. COCHERY, the Minister of Postal Telegraphy in France, has printed a circular extending the use of telephones to provincial cities. The charge for telphonic communications in the cities where the government will establish central halls, is 10*l*., and in the cities where the number of subscribers will exceed 300, the subscription will be reduced to 8*l*. a year. The subscribers will have the right of supplying their own telephones from among those approved by the Government. Special rooms will be fitted up in Paris, as well as in the provinces for telephonic conversations. The charge will be 5*d*. from each interlocutor for each five minutes. The time allowed will not exceed ten minutes if there are other would-be interlocutors waiting. The telegrams received for the subscribers to the telegraphic offices will be telephoned to them if desired. The subscribers will enjoy the privilege of telephoning their letters to the Post Office for immediate despatch, on paying a charge of 5*d*. for each 100 words; this privilege is limited to 200 words, the postage must be paid besides. Telegrams will be received in the same manner and on the same scale.

DURING the last two or three years a bark containing quinine and quinidine has been imported into this country from Columbia in such enormous quantities as to equal or even sometimes exceed the whole of the importations of cinchona bark from all other countries. The botanical source of this bark, which is known in commerce under the name of Cuprea Cinchona, on account of its peculiar coppery tint, has hitherto been a mystery. M. Triana, the well-known quinologist, has recently succeeded in tracing it out, and has stated, in the *Pharmaceutical Journal* for April 22, that it is derived in great measure from two species of the nearly allied genus *Remijia*, none of the members of which were previously known to contain quinine. Several species of *Remijia* have leaves resembling those of the true Cinchonas, and of these M. Triana has determined that *R. Purdieana*, Wedd., and *R. pedunculata*, Karsten, certainly yield Cuprea bark, the former being the species which contains the alkaloid Cinchonamine, recently discovered by M. Arnaud. It appears probable that other species also yield the Cuprea Cinchona of commerce, but definite information on this point is still wanting. The value of this bark has led, according to M. Triana, to great devastation of the forests in which the trees grow, and has produced a financial stagnation, business being neglected in order to follow the more profitable occupation of collecting the bark. Fortunately seeds of the tree have been received and are now in cultivation at Malvern House, Sydenham. The tree is likely to prove valuable for cultivation in countries where malarial fever abounds, since it grows at an elevation of 200-1000 metres above the sea, at which even red Cinchona bark will not flourish.

A SATISFACTORY *Report* for 1881 has been issued by Mr. Paton, curator of the Kelvingrove Museum, Glasgow. The natural history collections especially have greatly increased during the past year, and if displayed properly, would themselves fill the Museum. It seems strange that so wealthy a city as Glasgow should be content to have their growing and valuable museum so inadequately housed.

DR. P. A. BERGSMA has resigned his appointment as Director of the Batavia Observatory, and is returning to Europe. We have often had occasion to refer to the good work done by Dr. Bergsma at this Observatory, especially on Meteorology.

MR. HENRY DYER, the efficient principal of the Imperial College of Engineering, Tokio, Japan, is about to return to this country.

THE death is announced of Col. J. T. Smith, R.E., F.R.S., for many years Master of the Mint at Madras, and the author of some valuable optical discoveries.

WE regret to learn of the death, at the early age of thirty-two, of a promising young science teacher and lecturer, Mr. Thomas Dunman, lecturer on Physiology at the Birkbeck Institution, and Physical Science Lecturer at the Working Men's College. His brief career furnishes a remarkable instance of what may be done by energy, perseverance, and a strong faith in one's own powers. Mr. Dunman has done excellent work in science teaching at both of the institutions mentioned. In 1879 he published a glossary of "Biological, Anatomical, and Physiological Terms," and finding his Lectures on Popular Scientific Subjects were so much appreciated, he commenced last year to issue them in pamphlet form.

MESSRS. BAILLIÈRE, TINDALL, AND COX have the following announcements:—A revised and enlarged edition of Harris and Power's "Manual for the Physiological Laboratory" will appear on June 1; a second edition of the Portrait-picture of the International Medical and Scientific Congress of 1881 is in course of preparation, with a few additional portraits; a second part of the President of the Royal College of Veterinary Surgeons' (Mr. Fleming) work on "Animal Plagues," from the beginning of the present century, will be published during the next few days.

PROF. ROSCOE, with other members of the Royal Commission on Technical Instruction, visited Vienna during the past week. Mr. Samuelson, M.P., the president of the Commission, and Mr. W. Woodall, M.P., left on Friday to join their colleagues at Dresden. After inspecting the schools and manufactories in Saxony, it is the intention of the Commissioners to proceed to Berlin.

WE have received copies of a circular letter and inclosures which have been issued to the scientific societies of the United Kingdom (with the exception of the Chartered London Societies, and the medical and some few other societies of a similar character) within the last few days. These papers are issued in pursuance of the resolutions adopted at the second Conference of Delegates of Scientific Societies held at York. Any society desirous of receiving these, or intending to send a Delegate or Delegates to the Southampton Meeting of the British Association, should apply to Mr. W. G. Fordham, Odsey Grange, Royston. Mr. Fordham would be obliged to secretaries of scientific societies, or any of our readers, who would assist him in compiling a complete list of the scientific societies of the United Kingdom, by sending him information, particularly with reference to the smaller provincial and local natural history societies, and similar bodies.

WE have received the Annual Reports of three local scientific societies—East Kent, West Kent, and Wellington College. They all speak favourably of the work of the past year and of the progress of the societies. The Report of the West Kent Society contains a sensible address on Evolution, by the president; and that of the Wellington Society shows that considerable improvement has taken place since the last report.

ON Saturday afternoon last the members of the Essex Field Club met in the private lecture-room in the Natural History Museum, South Kensington, at the invitation of Dr. Henry Woodward, F.R.S., who delivered a very interesting and instructive lecture on the "Ancient Fauna of Essex." The lecture was amply illustrated with specimens and diagrams, many of the latter being specially prepared for the occasion, and at its close Prof. Morris gave a brief *résumé* of the principal facts of the geology of the Thames and Roding Valleys. Dr. Woodward afterwards conducted the party through the palæontological galleries, and practically demonstrated many of the more remarkable forms referred to in his lecture.

THE funds voted by the French Government for the next Transit of Venus Expedition not being deemed sufficient, the great commission presided over by M. Dumas in consequence of the deficiency, is making an application to the Minister of Public Instruction for an extension of credit.

M. ELOY, a young aëronaut who executed on Sunday, May 7, an interesting ascent, reported at full length to the Academy of Sciences on the following day, is to make a series of scientific ascents from La Villette Gasworks, and has submitted to M. Dumas a detailed programme of his proposed observations. We may state that their bearing is mostly on the nature of clouds, their dimensions, their formation, their propulsion by the wind, and their situation in the several strata of air by which they are propelled. The questions proposed by M. W. de Fonvielle to Dr. Hermann Kopp will be solved as far practicable.

A LARGE Lacustrine canoe, in excellent condition, has been found near Bex, 4000 feet above the sea-level, and nearly 3000 feet above the Valley of the Rhone. No Lacustrine relics have ever before been met with in Switzerland, at such an elevation.

AN International Hygienic Conference is to be held in Geneva in September next.

WE regret to learn that the Hygienic Exhibition which was in preparation in Berlin has been almost destroyed by fire; but the Committee have resolved to carry out the enterprise next spring.

HIS EXCELLENCY the Marquis of Lorne, Governor-General of Canada, has instituted a Society for the "Advancement of Literature and Science in the Dominion of Canada," the first meeting of which is fixed to take place in the city of Ottawa on May 25, 26, 27. The President is Principal J. W. Dawson, C.M.G., F.R.S.

THERE is an interesting paper in the last number of the *Revue Scientifique*, by M. Ch. Cornevin, on the Domestication of the Horse.

IN connection with the election of M. de Freycinet to the Paris Academy of Sciences, it may be noted that not less than twenty-four members of the Senate belong to the several classes of the Institute of France, seven to the Academie Française, five to the Academy of Sciences, Morals, and Politics, five to the Academy of Inscriptions and Belles Lettres; of these twenty-four, not less than twenty are life-senators, whose number is only seventy-five, and seven have been ministers. In the French Lower House the number of Academicians is very small, only three—two of the Academy of Sciences, one of these having been minister, and one of the Academie Française.

PROF. FOREL distinguishes three regions in a glacier:—1. The *nevé* (*infancy* of the glacier). Excess of snow; the summer heat not sufficient to melt the snow of the year. All the water produced is absorbed and assimilated by the ice-layers; deep temperature below zero. 2. The *glacier adolescent.* Summer heat fuses all the snow of winter, and attacks by ablation a part of the ice. All the water of imbibition is absorbed and assimilated by the ice; deep temperature below zero, even at the end of summer. 3. The *glacier senile.* Summer heat is in excess. The water of imbibition exceeds the quantity necessary to re-heating of the ice, which rises to 0°, and the excess of water flows away in the glacial torrent. Temperature of the glacier at 0° during summer.

On May 8 three shocks of earthquake were felt at Laibach (Carniola), the first occurring at 9h. 38m. p.m., the last, at midnight, was the most severe, and, lasting two seconds; it was accompanied by a loud subterranean noise.

According to statistics recently worked out, the number of railway travellers killed in France is one in each 1,600,000,000 km. run, which is a distance equal to 40,000 times the length of a voyage round the world. This excursion would last during 3044 years travelling day and night at the rate of 60 kilometres per hour. So that, supposing an average life-time of sixty years for a healthy man, before he could be killed by a railway accident according to the law of probabilities, he would have died fifty times a natural death.

In the Report of the Paris Academy of Sciences for April 24 (Nature, vol. xxvi. p. 24) the statement with regard to Prof. Roscoe's paper "On the Equivalent of Carbon determined by Combustion of the Diamond" should read "Representing O by 15·96, C becomes 11·97." In the *Comptes Rendus* it is 11·07.

The additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♀) from India, presented by Mr. H. B. Hamer; a Common Paradoxure (*Paradoxurus typus*) from Java, presented by Mr. F. E. Spellerberg; a Black-faced Kangaroo (*Macropus melanops* ♀) from South Australia, presented by Mr. C. T. H. Bower; two Silver-backed Foxes (*Canis chama*) from South Africa, presented by Major-General E. A. Bacon; two Long-eared Owls (*Asio otus*), British, presented by Mrs. E. Brewer; two Alligator Terrapins (*Chelydra serpentina*), a Box Tortoise (*Terrapene*, sp. inc.), a Floridan Terrapin (*Clemmys floridana*) from North America, presented by Mr. G. E. Manigault; two Beautiful Finches (*Estrelda bella*) from Australia, presented by Mr. J. Abrahams; an Allen's Galago (*Galago alleni*) from Fernando Po, a Levaillant's Cynictis (*Cynictis penicillata*) from South Africa, a Common Otter (*Lutra vulgaris*), British, a Swinhoe's Pheasant (*Euplocamus swinhoii* ♀) from Formosa, five White-winged Choughs (*Corcorax leucopterus*), a Spotted Bower Bird (*Chlamydora maculata* ♂) from Australia, four Common Sheldrakes (*Tadorna vulpanser* ♂ ♂ ♀ ♀), European, two Talpacoti Ground Doves (*Chamæpelia talpacoti*) from South America, purchased; a Bennett's Wallaby (*Halmaturus bennetti* ♂), an American Bison (*Bison americanus*), born in the Gardens.

## OUR ASTRONOMICAL COLUMN

The Comet.—On May 12 the comet was within naked-eye vision, and will nightly increase in brightness. Writing from Cuckfield on May 13 Mr. G. Knott says: "The sky was very clear here last night, and I found that I could just see the comet with the naked eye, on knowing just where to look for it. I fancy that its visibility must have been in part due to the fact that its tail is pretty bright for about ¾°. When viewed with an opera-glass its light seemed hardly equal to that of neighbouring stars rated 6·7 (*i.e.* 6⅔) by Heis, and 6·5 by Argelander in D.M. In the telescope the light of the head seemed about equal to that of a 7 mag. star." This estimate by so careful and experienced an observer of star-magnitudes will furnish a reliable criterion as to the future increase in the brightness of the comet, assuming that it follows the ordinary theoretical rule.

The following orbit has been calculated by Mr. Hind from the observations at Harvard and Albany, U.S., on March 19, one at Paris on April 11, and a position obtained at the Royal Observatory, Greenwich, on May 4:—

Perihelion passage, 1882, June 10·51851 G.M.T.

| | ° ′ ″ | |
|---|---|---|
| Longitude of perihelion ... ... | 53 54 23·2 | Mean Equinox, 1882·0. |
| ,, ascending node... | 204 53 31·3 | |
| Inclination... .. ... ... ... | 73 46 23·2 | |
| Log. perihelion distance... ... | 8·783187 | |

Motion—direct.

By a meridian-observation at Greenwich on May 12 (eight days after the last observation employed for the orbit), which Mr. Christie has caused to be reduced with every precision, the corrections to the computed place were: $\Delta\alpha \, . \cos\delta = -9''{\cdot}0$; $\Delta\delta = +28''{\cdot}5$. Differential observations at the Collegio Romano, in Rome, on May 10, kindly communicated by Prof. E. Millosevich, give $\Delta\alpha \, . \cos\delta = -20''{\cdot}6$, and $\Delta\delta = +26''{\cdot}0$, parallax and aberration being taken into account.

The ephemeris subjoined is calculated from these elements for Greenwich midnight:—

| | R.A. h. m. s. | Decl. ° ′ | Log. dist. from Earth. | Intensity of light. |
|---|---|---|---|---|
| May 20 | 2 53 31 | +67 15·1 | 9·9494 | 1·67 |
| 21 | 3 5 49 | 65 51·0 | 9·9494 | |
| 22 | 3 16 51 | 64 22·5 | 9·9496 | 1·92 |
| 23 | 3 26 46 | 62 50·1 | 9·9502 | |
| 24 | 3 35 42 | 61 14·2 | 9·9511 | 2·24 |
| 25 | 3 43 45 | 59 35·2 | 9·9523 | |
| 26 | 3 51 2 | 57 53·1 | 9·9538 | 2·64 |
| 27 | 3 57 39 | 56 8·1 | 9·9557 | |
| 28 | 4 3 42 | +54 20·6 | 9·9580 | 3·18 |

Considering that the comet is still at a great angular distance from the perihelion and the heliocentric motion slow, the following places for the beginning of June can be regarded as approximate only:—

*At Greenwich midnight*

| | R.A. h. m. | Decl. ° ′ | Log. distance. | Intensity of light. |
|---|---|---|---|---|
| June 2 | 4 27·1 | +44 35 | 9·9747 | 6·0 |
| 3 | 4 30·8 | 42 27 | 9·9794 | 7·1 |
| 4 | 4 34·5 | 40 12 | 9·9845 | 8·8 |
| 5 | 4 37·8 | 37 51 | 9·9902 | 11·2 |
| 6 | 4 41·2 | 35 20 | 9·9965 | 15·2 |
| 7 | 4 44·8 | +32 36 | 0·0036 | 22·6 |

The intensity of light on May 12, when Mr. Knott made his estimate of the comet's brightness, is here taken as the unit.

At noon on June 10, the intensity of light referred to this unit is 147, and at noon on June 11 it is 154. The probability of seeing the comet near the sun on these days is not now so great perhaps as it appeared to be from the earlier orbits.

At the meeting of the Royal Astronomical Society on the 12th inst., the Astronomer Royal referred to the absence of bright lines in the spectrum of the comet, according to repeated observation at Greenwich. It will be interesting to watch the comet's development as it approaches the sun.

## BINOCULAR PERSPECTIVE

That a near object, of small size, presents an aspect slightly different to each one of a pair of eyes directed upon it seems to have been known since the time of Euclid; but not until the present century has binocular vision been made a subject of special study.

In 1838 Wheatstone presented a communication on the Physiology of Vision (*Phil. Transactions*, 1838, Part 2, reprinted in *Phil. Magazine*, s. 4, vol. iii. April, 1852) to the Royal Society, in which he described his invention of the reflecting stereoscope, by which rays from two slightly dissimilar pictures were conveyed into the right and left eyes respectively, producing the visual illusion of binocular relief. The essential feature of this instrument he describes by saying (*Phil. Mag.* April, 1852, p. 245): "The two pictures, or rather their reflected images, are placed in it at the true concourse of the optic axes."

In 1844 Brewster published an essay (Edinburgh *Transactions*, vol. xv. Part 3, p. 360) "On the Knowledge of Distance given by Binocular Vision," in which he elaborated the idea that the apparent position of the combined image produced by rays, from a pair of conjugate pictures, upon corresponding retinal points of the two eyes, is determined by the intersection of visual lines passing through conjugate points. He deduced a formula and constructed a table of apparent distances, thus determined, for various values of the angle of convergence between the visual lines.

In 1849 Brewster described his invention of the lenticular stereoscope (*Phil. Mag.* 1852, p. 16) and of the binocular camera, by which slightly dissimilar pictures of the same object may be simultaneously obtained for examination in the stereoscope. Various modifications of the instruments already in use were explained, and in all of them the apparent position of the combined image was referred to the point of convergence of the visual lines, these being determined by the direction of rays on entering the eyes after reflection or refraction in the stereoscope.

In 1852 Wheatstone published a second paper (*Phil. Mag.* 1852, p. 504) on the Physiology of Vision, in which he discussed the effects of varying the angle of convergence between the visual lines, and also the distance of the pictures from the mirrors of the reflecting stereoscope. He makes no reference to divergence of visual lines, but, like Brewster, he subjoins "a table of the inclinations of the optic axes, which correspond to the different distances," which is also applicable to the binocular camera.

In direct binocular vision of a single point in front the interocular line is the base of an isosceles triangle, whose two sides are the visual lines. Helmholtz ("Optique Physiologique," p. 93) has shown that the latter are not coincident with the optic axes, but practically they may be regarded as axial in relation to the crystalline lens. For distinction it will be convenient to call them visual axes, their intersection the optic vertex, and the angle inclosed the optic angle, as has been customary.

Let $i$ = interocular distance,
,, $\alpha$ = optic angle,
,, D = distance of optic vertex from each eye,
Then
$D = \frac{1}{2} i \operatorname{cosec} \frac{1}{2} \alpha$.
If $\alpha = 0$, $D = \infty$, and visual axes are parallel.
If $\alpha < 0$, $D < 0$, and visual axes are divergent.

Wheatstone notices the exaggeration of perspective produced when a pair of conjugate pictures, taken with a large angle between the camera axes, are viewed in the stereoscope with the visual axes nearly or quite parallel. He mentions, as a remarkable peculiarity (*Phil. Mag.* 1852, p. 514), that "although the optic axes are parallel, or nearly so, the image does not appear to be referred to the distance we should from this circumstance suppose it to be, but it is perceived to be much nearer. It seems as if the dissimilarity of the projections, corresponding as they do to a nearer distance than that which would be suggested by the former circumstance alone, alters in some degree the perception of distance."

The last explanation is obviously inapplicable if two perfectly similar pictures can be binocularly seen as one, with parallelism or divergence of visual axis. This condition is easily imposed by placing before one eye a thin prism with its edge outward. A single object in front is seen double until the visual axis diverges enough to make the two images coincide in retinal position. To test the strength of the external rectus muscles of the eye-balls, this method has now been in use for many years by oculists. The same effect may be attained by drawing a pair of conjugate pictures apart until binocular fusion of their images ceases to be possible. Divergence of visual axes, to the extent of 8°, has been thus obtained by Helmholtz ("Opt. Phys.," p. 616), and of 7½° by the present writer. Since this point of meeting is, in these cases, in the rear of the observer, the theory of binocular prospective held by Wheatstone and Brewster is incorrect. It is nevertheless given without qualification, either directly or implicitly, in most, if not all, of our text-books of physics.

No analysis of the phenomena of binocular vision by axial divergence has thus far been published,

Helmholtz mentions the exaggeration of apparent distance thus produced, and adds ("Opt. Phys. p. 828") that "in our visual conceptions infinity is not presented as an impassable limit." He accounts for this by stating that in abnormal vision "all we can do is to compare the sensation produced with that which it resembles most in normal vision."

By examination of a large number of stereographs and lenticular stereoscopes, I have found (*Am. Journ. of Science*, November and December, 1881) that in using them, slight axial divergence is very frequently practised. It is nearly always necessary when binocular fusion of images is obtained, in regarding stereographs by voluntarily diminishing the natural convergence of visual axes without the aid of the stereoscope. The assumption of axial convergence, as if in normal vision, is unnecessary and misleading; it should be entirely discarded in explaining vision through the stereoscope. What is really necessary is that the camera axes from corresponding points of the stereograph, at the moment the picture is taken, shall converge; and that these points shall be imaged upon corresponding points of the two retinas. The visual axis may then be either convergent, parallel, or divergent. The visual effect will vary with these conditions, but by no means in accordance with the mathematical formula given above. I have described elsewhere (*Am. Journal of Science*, November and December 1881) a method of determining approximately the apparent position of the object regarded in the stereoscope, rejecting the hypothesis that the visual axis must necessarily converge. It remains to discuss the effect of making the optic angle alternately positive and negative. Helmholtz's conclusion that the only resource, when the visual axes diverge, is to compare the sensation produced with that which it resembles most, is unnecessary. No such resource in the present case would have been needed, even temporarily, had not undue stress been laid upon the convergence of visual lines.

From the fact that a pair of similar images upon corresponding retinal points produce the same impression, as if coming from the same external point, there result two consequences of fundamental importance in binocular vision, on which depends tde explanation of all vision with axial divergence. One is that both eyes are subjectively combined into a single central binocular eye, composed of two eyes coincident in position, each of them receiving its own image, which is wholly or partly superposed on that of the other. This observation is due to Hering (Hering, "Beiträge zur Physiologie," 1861, p. 35-64, or Helmholtz, "Opt. Phys," p. 777), and has been extended and applied by Prof. Le Conte (*Am. Journal of Science*, S. III. vol. i., p. 33, and vol. ii. p. 1, or "Sight," Appleton and Co., New York, 1881, pp. 213-261). The two visual lines terminating on corresponding retinal points are hence subjectively combined into a single median line, to some point of which the binocular image is referred. The apparent position of this point of sight, however, is the result of a judgment, and not a mathematical determination. In normal binocular vision the judgment of distance may accord very nearly with what might be determined by the intersection of visual lines, but there is no necessary coincidence.

The second consequence is that a point farther or nearer than the point of sight is necessarily seen double, because imaged upon retinal points that do not correspond. Conversely, if conjugate points of a stereograph are imaged upon non-corresponding retinal points, fusion can be accomplished only by changing the relation between the visual axes. To the binocular eye, therefore, such points will appear farther or nearer than the point of sight. On these two principles depends, in large measure, the perception of binocular relief.

The perception of relative distance depends upon a variety of conditions, which must be eliminated before binocular perspective is studied. There are then left still three elements to consider:—

1. The optic angle.
2. The focal adjustment of the crystalline lens.
3. The retinal magnitude of the binocular image.

The import of the first of these depends upon the relative degree of tension in the rectus muscles of the eyeballs; of the second on the tension of the ciliary muscle; of the third on the relation between the magnitude and distance of the object. The judgment of distance and size depends upon the acquired skill of the observer in interpreting the sensations due to variation of these elements. This variation is best accomplished with the aid of a modified Wheatstone stereoscope.

Let the stereoscope be so arranged that the visual axis may successively inclose every possible angle between the limits beyond which vision becomes impossible. On its arms let a pair of conjugate pictures be kept at a fixed distance each from its mirror. If the arms be so placed that the optic angle is that of normal vision, the point of sight approximately coincides with the optic vertex, and to the distance of this the focal adjustment is adapted.

Let $\alpha$ = optic angle, varied by means of the stereoscope.

,, $\alpha'$ = optic angle of normal vision for given distance.

,, D = distance of optic vertex from each eye, determined by the formula, $D = \frac{1}{2} i \operatorname{cosec} \frac{1}{2}\alpha$.

,, D′ = distance of radial point measured in the direction from which the reflected ray enters the eye. It is hence the distance of the virtual image in normal vision.

,, A = distance of point of sight from binocular eye.

Under the conditions given above we have—

$\alpha = \alpha'$, and $A = D = D'$. Assume $D' = 50$ cm., then $\alpha' = 7° 20'$.

If now we make $\alpha = 37° 20'$, we have $D = 10$ cm. But to secure distinct vision, the focal adjustment must be adapted to D′, and therefore dissociated from the axial adjustment. This to some extent antagonises the effect of tension of the internal rectus muscles, and this antagonism is increased by the fact that the visual angle remains constant. The combined effect is that $A > D$ but $A < D'$. The apparent size of the image is diminished in the ratio of A to D′. The effect of increasing the optic angle is hence to make the image appear nearer, smaller, and less deep in proportion to its area, but more distant nevertheless than the new optic vertex.

If now we make $\alpha = -5°$, we have $D = -73{\cdot}4$ cm., but the relaxation of the internal rectus and contraction of the external rectus muscles causes the image to appear to recede in a positive direction. This illusion is opposed by the constancy of the visual angle, and the ciliary effort to keep the focal adjustment adapted to D′. The result is that $A > D'$, and the apparent size of the image is enlarged in the same ratio, while its depth is increased still more. The effect of making the optic angle negative is hence to cause the image to appear farther, larger, and deeper in proportion to its area.

If in the discussion just given we make $\alpha$ the angle between a pair of camera axes, and D the distance of its vertex, while $i$ is the distance between the two lenses, the formula is readily applicable, but $\alpha$ can have only positive values. The optic angle for the observer while using the stereoscope is not necessarily, or even generally, the same as that between the camera axes when the picture was taken. Apparent distance in the stereoscope is thus not determined by the intersection of the observer's visual lines, and no mathematical formula can be made to apply to the interpretation of muscular tension in the muscles of the eyes. The error into which Wheatstone fell, and which was repeated and emphasised by Brewster, consists in the application of geometry where physiological conditions are such as to destroy the value of all geometric constructions. Unfortunately this error is still repeated in most of our text-books of physics, wherever diagrams are employed to explain the theory of the stereoscope.

W. LE CONTE STEVENS

New York

## SCIENTIFIC SERIALS

*The Quarterly Journal of Microscopical Science* for April, 1882, contains—Pringsheim's researches on chlorophyll, translated and condensed by Professor Bayley Balfour (with plates 8 and 9).—Dr. D. H. Scott, on the development of articulated laticiferous vessels (plate 10). In the plants investigated, the vessels arose from rows of cells, of which the cross walls, and where two were in contact, the side walls in part became gradually absorbed. This took place very early; when not in contact, connection took place by means of cross rows of cells, which underwent fusion, or by inoculating outgrowths, before absorption; such cells showed the probable presence of latex.—Dr. E. Klein, on the lymphatic system and the minute structure of the salivary glands and pancreas (plates 11 and 12).—Prof. F. M. Balfour and F. Deighton, a renewed study of the germinal layers of the chick (plates 13–15).—Isao J. Iijima, on the origin and growth of the eggs and egg-strings in Nephelis, with some observations on the "spiral asters" (plates 16–19).—Dr. A. A. Hubrecht, a contribution to the morphology of the Amphineura.—Prof. E. Ray Lankester, on the chlorophyll-corpuscles and amyloid deposits of Spongilla and Hydra (plate 20). These forms are not of the nature of parasitic bodies, but they correspond in structure with the chlorophyll bodies in plants.

*Journal of the Royal Microscopical Society* for April, 1882, contains the President's address, by Prof. B. Martin Duncan.—On mounting objects in phosphorus, and in a solution of biniodide of mercury and iodide of potassium, by J. W. Stephenson.—On the threads of spider webs, by Dr. J. Anthony.—With the usual most useful summary of current researches relating to geology and botany, and the Proceedings of the Society.

*Journal of Anatomy and Physiology, Normal and Pathological*, vol. xvi. Part 3, April, 1882, contains—Dr. A. M. Marshall, the segmental value of the cranial nerves (pl. 10).—Dr. G. E. Dobson, the anatomy of *Microgale longicauda*, with remarks on the homologies of the long flexors of the toes in mammalia.—Dr. T. P. A. Stuart, the curled hair and curled hair follicles of the Negro.—Dr. G. Sims Woodhead, some of the pathological conditions of the medulla oblongata, in a case of locomotor ataxia (pl. 11).—Dr. M. Hay, on the action of saline cathartics.—W. J. Walsham, abnormal origin and distribution of the upper seven right intercostal arteries, with remarks.—Dr. W. Stirling, on the digestion of blood by the common leech, and on the formation hæmoglobin crystals (pl. 12).—Prof. Turner, on a specimen of *Mesoplodon bidens*, captured in Shetland; and on a specimen of *Balænoptera borealis*, or *laticeps*, captured in the Firth of Forth.—G. S. Shattock, note on the anatomy of the Thyro-arytenoid muscle in the human larynx.

*Johns Hopkins University. Studies from the Biological Laboratory*, vol. ii. No. 2 (March, 1882), contains: W. K. Brooks, Medusæ found at Beaufort, N.C., during the summers of 1880 and 1881, and on the development of the ova in Salpa.—J. P. McMurrich, on—the origin of the so-called "test cells" in the Ascidian ovum.—G. M. Sternberg, bacterial organisms commonly found on exposed mucous surfaces and in the alimentary canal of healthy persons;—on a fatal form of Septicæmia in the rabbit from the subcutaneous injection of human saliva;—on experiments with disinfectants.—H. N. Martin, observations on the direct influence of variations of arterial pressure upon the rate of beat of the mammalian heart.—W. H. Howel and M. Warfield, the influences of changes of arterial pressure upon the pulse rate in the Frog and the Terrapin.—H. Garman and B. P. Colton, notes on the development of *Arbacia pustulata*.—K. Mitsukuri, on the structure and significance of some aberrant forms of lamellibranchiate gills.—E. B. Wilson, on the early developmental stages of some polychætous annelides.

*The American Naturalist* for April, 1882, contains—On mound pipes, by E. A. Barber.—On the flowers of *Solanum rostratum* and *Cassia chamæcrista*, by J. E. Todd.—Is Limulus an arachnid? by A. S. Packard; a criticism on the views of Prof. Lankester.—On a pathogenic Schizophyte of the hog, by H. J. Detmers.—On Mexican caves with human remains, by Ed. Palmer.—The Editor's table.—Recent literature.—General notes, and scientific news.

May, 1882, contains—The acorn-storing habits of the Californian woodpecker, by R. E. C. Stearns.—Observations on some American forms of *Chara coronata*, by T. F. Allen.—The löess of North America, by R. Ellsworth Call.—The ichthyological papers of G. P. Dunbar, with a sketch of his life by J. L. Wortman.—Problems for zoologists, by J. G. Kingsley.—Recent literature.—General Notes.—Scientific news.

*Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien*, Bd. xxi. Heft 2, 1882, contains: Josef Mik, dipterological studies, II. (pl. xvi.), and notes on G. Strobl's discoveries of Diptera at Seitenstetten.—Ed. Ritter, on the Pselaphidæ and Scydmaenidæ of Syria; analytic key to the European Coleoptera, V. (pl. xix.).—C. R. Osten-Sacken, list of the entomological writings of Rondani (supplementary to Hagen).—J. Freyn, supplement to the flora of South Istria.—H. B. Möschler, contributions to the butterfly fauna of Surinam, IV. and end (pls. xvii. and xviii.).—A. Rogenhofer and Dr. R. W. v. Dalla Torre, on the Hymenoptera of Scopoli's "Entomologica Carniolica."—August Pelzeln, on the second package of birds sent by Dr. E. Bey from Central Africa.—Dr. L. W. Schaufuss, zoological results of an excursion to the Balearic Islands (pl. xxi.).—Dr. L. Koch, the Arachnida and Myriopoda of the Balearics (pl. xx. and xxi.).—Schulzer v. Müggenburg, mycological notes, VI.—L. Ganglbauer, analytic tables of European Coleoptera (pl. xxii.).—A. B. Meyer, on birds from some of the southern islands of the Malay Archipelago.—Johann Bubela, list of the wild plants of Bisenz in Moravia.

*Archives des Sciences Physiques et Naturelles*, April 15.—The grain of the glacier, by F. A. Forel.—Note on the extension of a property of gases to liquids and to solids, by C. Cellérier.—Recent changes in the appearances of Jupiter, by E. Gautier.

*Atti della R. Accademia dei Lincei*, vol. vi. fasc. 8.—Observations on the topography of the planet Mars, by G. Schiaparelli.—Communication on a geyser discovered at Montrond (Loire), by F. Lauri.—On the same subject, by F. Keller.—On the embryo of *Cuphea*, by G. Briosi.—Influence of different electric resistances on the dimensions of the excitative spark of condensers, by E. Villari.—On the dynamical value of a calorie, by G. Cantoni and G. Gerosa.—Oxidation of titanic acid, by A. Piccini.—Reports.

*Morphologisches Jahrbuch. Eine Zeitschrift für Anatomie und Entwickelungsgeschichte*, Bd 7, Heft iv., 1882, contains—Dr. Hans Virchow, on the lens and retinal vessels of the eel (pl. 27).—Dr. Sigbert Ganser, comparative anatomy studies of the brain of the mole, pp. 590, 725 (plates 28-32.—A most minute and painstaking account of the mole's brain), Dr. W. Pfitzner.—On nerve-endings in epithelium (pl. 33).

## SOCIETIES AND ACADEMIES

### London

**Mathematical Society**, May 11.—S. Roberts, F.R.S., president, in the chair.—Mr. A. L. Daniels was elected a Member.—Dr. Hirst, F.R.S., communicated an account (similar to that he had given before the Royal Society in the afternoon of the same day) of a paper by M. Vanecek entitled "Sur l'Inversion générale."—The following further communications were made:—Elementary analytical proof of Graves's and MacCullagh's theorems, with an extension of the former, by J. Griffiths.—Note on a system of confocal bicircular quartics, by R. A. Roberts.—On the vibrations of an elastic sphere, by Prof. Lamb.—On a formula relating to elliptic integrals of the third kind, by Prof. Cayley, F.R.S.; and a short note by the president.

**Physical Society**, May 6.—Prof. Clifton, president, in the chair.—New Member, Mr. W. H. Heaton.—Mr. Lecky described a form of battery arranged by Mr. A. R. Bennet, of Glasgow, at a cost of *6d.* per cell. The vessel and electro-negative plate consists of an iron meat or milk tin, into which is placed a porous pot containing a zinc plate stuck in a paraffined cork cover, fitting the porous pot. A solution of caustic soda is the liquid. In it iron does not rust, and is electro-negative to zinc. The electromotive force is 1·23 volts where the Daniel is taken as 1 volt and the Leclanché as 1·30 volts. Iron filings round the iron plate facilitate depolarisation by the escape of hydrogen from their points. The cell pitted against a Leclanché was found to ring an electric bell even longer than the latter.—Prof. Guthrie (in the absence of Dr. F. D. Brown, the author) gave a summary of a paper entitled "Notes on Thermometry." This described a method of calibrating the tubes by means of a microscope having an extra half-lens before the object-glass, which focussed the end of the mercury column, whilst the other lens focussed the tube, so that no alteration of the focus of the microscope was necessary in making an observation. Dr. Brown also found that a constant zero temperature was better obtained from a mixture of ice and water than from drained ice; and that it was preferable to mix the ice with distilled water rather than ordinary water. Acting on the suggestion of Dr. Guthrie, Dr. Whipple, of Kew, had found that the ice itself might be from different sources without appreciably affecting the result. Dr. Whipple called attention to the change of zero in thermometers by heating, and recommended buyers to see that makers had not let them be heated after their calibration. Mr. J. Macfarlane Gray suggested that the thermometers used by Regnault should be examined now, as our standards are based on his results. Prof. Clifton pointed out that the half-lens in the microscope would probably distort the image of the mercury column.—Prof. Guthrie then read a paper on the repulsion of a suspended horseshoe magnet by a rotating copper disc below it. He gave tables of quantitative results and a plotted curve, showing that the repulsion varied on the square of the rate of rotation. For a surface velocity of the disc of 163 metres per minute the repulsion was ·41 grammes.

**Anthropological Institute**, May 9, Major-General Pitt Rivers, F.R.S., president, in the chair.—The election of Mr. Henry Ling Roth was announced. Mr. G. M. Atkinson made some remarks upon a palæolithic implement found eighteen feet below the bed of the Thames at Chelsea, and exhibited by Mr. Lambton Young, C.E., and a jet ornament from Garvagh, co. Londonderry, exhibited by Mr. A. G. Geoghegan. — Mr. Worthington G. Smith exhibited a series of large palæolithic implements recently discovered.—Dr. Beddoe, F.R.S., read a paper on the evidence of surnames as to ethnological changes in England. The discussion was sustained by Messrs. Hyde Clarke, Holt, Park Harrison, Prideaux, Atkinson, C. Roberts and the chairman.—Mr. Park Harrison, M.A., read a paper on the survival of certain racial features in the population of the British Isles at the present day. Dr. Beddoe, Prof. Thane, Mr. Atkinson, and the president joined in the discussion.

**Institution of Civil Engineers**, May 9.—Sir Frederick Bramwell, vice-president, in the chair.—The paper read was on "Coal Washing," by Mr. Thos. F. Harvey, Assoc.M.Inst.C.E.

**Royal Horticultural Society**, May 9.—Sir J. D. Hooker in the chair.—*Larches attacked by Larvæ:* From a communication received by Sir J. D. Hooker it would appear that the trees mentioned in the last report had suffered much more extensively than was supposed, whole trees having been stripped of their foliage.—*Fungus in Dilute Sulphuric Acid:* Mr. W. G. Smith exhibited a specimen of the vinegar fungus, *Penicillium crustaceum*, growing in dilute sulphuric acid. Sir J. D. Hooker suggested it should be ascertained what nitrogenous substance was present in the acid, which alone could not support life.—*Proliferous Mushroom:* He also exhibited a specimen in which one pileus was inverted and adherent to the summit of another mushroom growing in the ordinary way.—*Foliage Injured by the Gale:* Dr. M. T. Masters exhibited leaves injured in various ways by the late severe gale, which by destroying the growing parts only revealed the different developmental orders of leaves. It appeared that salt spray had injured trees in some cases; but it was thought that the duration and great cold of the wind was more generally the cause of injury. Beeches, it was noticed, withstood it better than oaks.

**Victoria (Philosophical) Institute**.—A paper was read by Prof. Lionel S. Beale, F.R.S., on "Dictatorial and Scientific Utterances and the Decline of Thought." The author tried to show that the opinion now generally entertained by scientific men that the phenomena of the living world are due to the properties of the material particles is erroneous.

### Berlin

**Physiological Society**, May 5.—Prof. du Bois Reymond, president, in the chair.—Dr. J. Sander read a paper upon the distribution of the vaso-motor nerve-centres. In addition to the well-known centre of the vaso-motor nerves in the medulla-oblongata, several other centres in the spinal chord were determined by the experiments that were made. In the case of each of these centres the degree of stimulation was determined which produced the greatest effect, and beyond which no further excitation produced a rise in the blood-pressure. If this degree of maximum excitation was not reached, a cumulative effect was perceived by the simultaneous stimulation of two vaso-motor centres, and the weak excitation of two centres had always a much greater effect than that which would have been expected to result from the degree of stimulation. The increased blood-pressure that resulted from the stimulation of the centre lasted for a prolonged period, which proves that the smooth muscular tissue of the walls of the blood-vessels does not tire quickly.—In a previous meeting of the Society held on March 29, Dr. R. Koch had demonstrated his important discovery that tuberculosis is a parasitic disease, that its occurrence is connected with the presence of tubercle Bacillæ, which are always found in those tissues which had undergone tubercular change. The Bacillæ can be isolated and can be cultivated for long periods quite isolated; animals that were infected with the isolated bacteria by very different methods became, without exception, affected with tuberculosis. The important demonstration of these tubercle Bacillæ was accomplished by Dr. Koch by a staining method which consisted in the employment of an alkaline solution of methyl-blue and a watery Vesuvian solution (*Vesuvialösung*); under this treatment all tissues and cells became stained brown, while the tubercle Bacillæ alone became stained blue; by this means it was easy to demonstrate the tubercle Bacillæ in the excreta of consumptive patients, in which they regularly occur. This interesting relation of the tubercle-Bacillæ to the staining-fluids has been made the subject of investigation by Dr. Ehrlich, the principal results of which may be condensed into the statement that the cause of this extraordinary appearance lies in the particular properties of the ectoderm of the tubercle-Bacillæ, which is penetrable by alkaline fluids, and therefore also for alkaline methyl-blue, whereas it is impenetrable by neutral substances, and especially by acids. Even the application of the strongest mineral acids, such as sulphuric acid, nitric acid, and such like, produced no effect on the Bacillæ. This peculiarity of the tubercle-Bacillæ has, besides its scientific, also, a remarkable practical importance, as it teaches that no acid fluids are to be use d in disinfection, or for the purpose of killing tubercle-Bacillæ, as their ectoderm is impenetrable by such, but that alkaline-solutions are to be used, as they become easily diffused into the interior and destroy the Bacillæ.—Prof. Baumann reported on the examination of two pieces of a Termite's nest, which Prof. Renlau had brought from Australia. The one piece was taken from the outer wall of a structure that was apparen ly inhabited by ants; the second came from the inner structure of the nest. The first was free from organic matter, and consisted almost entirely of clay containing iron; the second was of a brownish-colour, perforated in all directions with numerous passages, and consisted almost entirely of organic material. While the most careful microscopical examination did not reveal any trace of an organic structure, still on the other hand a chemical analysis showed a chemical composition very like that of most woods. Both the proportion of carbon and the amount and composition of the ash showed that this structureless substance is most nearly allied to wood. Mr. Baumann, consequently, looked for cellulose in the wall of the nest, and found it present in large quantities, so that there hardly remained a shadow of doubt but that the mass was derived from wood. The specific gravity was found to be 1·36, *i.e.* greater than that of the heaviest woods. The other constituents of this substance, which consisted of 97 per cent. of organic materials, afforded no assistance in the solution of the question as to whether this structureless mass had been formed out of wood, or as to how it had been manufactured by the animals.

### Paris

Academy of Sciences, May 8.—M. Jamin in the chair.—The following papers were read:—On the effects produced in vacuum by the current of Gramme machines, by MM. Jamin and Maneuvrièr. In an electric egg, with carbons (vacuum about 12mm.), a phenomenon like that of Geissler tubes is produced by the two currents, which contribute equally; but it is much more brilliant; the carbons soon get heated to a pale white throughout, and volatilised, giving a blue vapour, which condenses, and makes the egg opaque. This volatilisation was mostly avoided, in another case, by using two groups of carbons (instead of the pair) diverging from the rheophores towards each other, cone-wise. A large number of *effluves* here take the place of one. Still brighter effects were had with copper rods so arranged.—General considerations on preventers of fire, or pyroscopes, by M. Ledieu. After noting the faults of some methods, he indicates a system in which a cylinder of strong insulating material, holding a liquid which is refractory to electrolysation, and has good conductivity, increasing decidedly with temperature, is interposed in a single circuit, a platinum rheophore entering the liquid at either end. Absolute alcohol is a suitable liquid.—M. de Freycinet was elected Free Member in place of the late M. Bussy.—Report on a memoir relating to albuminoid matters, was presented to the Academy by M. Béchamp. The author has determined the rotatory power of a large number of these matters, and given elementary analyses of the best characterised species. The power, which fibrine has, of decomposing oxygenated water, resides, M. Béchamp proves, in the granular substance (albuminoid), left as an insoluble residue, on treatment of fibrine with weak hydrochloric acid. Raised to boiling in water, this loses its power. Again, M. Béchamp shows that it is a property of all albuminoid matters (as of albumen), that their oxidation by means of permanganate of potash furnishes a certain quantity of urea.—Report of the Commission charged to examine the work presented by Rear-Admiral Serre "On the Athenian Trireme."—Researches on one of the principal bases of doctrines relative to the mechanism of production of voluntary movements and convulsions, by M. Brown-Séquard. It must be allowed that the excitomotor zone of the cerebral surface and of all excitable parts of the brain can set in motion the limbs of the corresponding side like those of the opposite side, and this after transverse section of a lateral half of the bridge of Varoli, the bulb, or the cervical cord, or even after two sections—one of the right, the other of the left half of the base of the brain—provided there is a certain interval between the sections.—On the winter egg of phylloxera, by M. Henneguy.—On the spherical representation of surfaces, by M. Darboux.—On the tides of Campbell's Island, by M. Bouquet de la Grye. *Inter alia*, the retardation of the tide is twenty-four hours.—Remarks on the velocity of light, on the occasion of two memoirs of Lord Rayleigh, by M. Gouy. Both appear to have come to the same conclusions and formulæ independently. M. Gouy obtains the result (among others) that *perfectly homogeneous* light is necessarily formed of an indefinite series of equal waves, without perturbations or irregularities of any sort.—On the depression of the zero point in mercury thermometers, by M. Crafts. The greater the interval between the temperature that has produced a depression, and that at which the thermometer is kept to raise it again, the slower is the movement, and it may be incomplete if the interval considerably exceeds 100°. M. Crafts gives a table by which the depressions through heating Paris thermometers may be estimated.—On the polarisation of electrodes and the conductivity of liquids (continued), by M. Bouty. He results obtained by the method previously indicated. He gives extends to the case of mixtures M. Berthelot's law for that of simple electrolytes.—Magnetic variations of magnetised bars during thunderstorms, by M. de Lalagade. With a thin iron membrane mounted, as in a telephone, at the end of a magnetised steel bar, he heard a small dry sound at each lightning-flash. Better effects were had with twelve horizontal magnets, each having twelve coils at one end, the wires connected with two conductors and two telephones. Sounds were heard before as well as during each flash.—On a balloon ascent at Paris on May 7, 1882, by M. Eloy. Starting about midday they rose 300 m. in a south-east current, then to 1400 m. in a north-east one, above which a south-east current was met with again. Up to 1400 m. the average fall of temperature was 1° for 100 m., but at 1900 m. (the highest point reached), the thermometer was above the indication at 1400°.—On the composition and the equivalent in volume of pernitric acid, by MM. Hautefeuille and Chappuis. The formula $NO_6$ is arrived at.—Action of potash on oxide of lead, by M. Ditte.—On phosphate of chromium, and its utilisation in chemical analysis and industry, by M. Carnot.—Studies on the photo-chemical reaction of peroxalate of iron, by M. Jodin. For several years he has used the substance in experiments on plant-physiology, to supply $CO_2$ to plants by decomposition in light. The quantity liberated varies considerably with the composition of the solutions.—On new carbo-siliciated compounds, by M. Colson.—On homologous and isomeric rosanilines, by MM. Rosenstiehl and Gerber.—Chemical composition of the ash thrown out by Vesuvius on February 25, 1882, by M. Ricciardi.—Study on the antiseptic properties of salicylic acid, by MM. Robinet and Pellet. They describe experiments with salicylised must, showing that beyond 0·3 gr. per litre, salicylic acid is a powerful antiseptic, and that at 1 gr. it destroys even the action of yeast.—A claim of priority, in the idea of the photographic gun, was put in for M. Leblond.

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