THURSDAY, NOVEMBER 27, 1879

THE SACRED BOOKS OF THE EAST

The Sacred Books of the East. Translated by various Oriental Scholars, and Edited by F. Max Müller. Vol. I. *The Upanishads*, Translated by F. Max Müller. Vol. II. *The Sacred Laws of the Aryas*, Translated by Georg Bühler. Vol. III. *The Sacred Books of China*, Translated by James Legge. (Oxford: The Clarendon Press, 1879.)

THE series of volumes, of which the first three have just been issued simultaneously, under the able editorship of Prof. Max Müller, are a very significant sign of our age. Their object is none other than to give to the public the sacred books of the historical religions of the world, translated into English by the best living scholars, without praise or disparagement, and with no reference to theological controversies or the needs of missionary zeal. The translations aim at being exact and faithful representations of the originals, so far as this is possible, and they are published in the interests of science, not of religious dogma. It is intended that the scientific student of religion should possess in them trustworthy materials on which to found his generalisations and build his conclusions. The fact that such a work should appeal to a large public is not so remarkable as the further fact that it has been published at the expense of a university once supposed to be the stronghold of a narrow orthodoxy.

It is difficult to realise that the days are not long past when the very conception of a scientific treatment of religion would have been regarded either with horror or with indifference. The religious world would have none of it; the fashionable world associated science with bones and machinery. The task of translating or of reading the sacred books of other peoples was left to a few zealots bent on destroying the Christianity of modern Europe, or a small band of scholars whose labours were almost unknown beyond the privacy of the study. In many cases, indeed, translation in the true sense of the word was impossible; scientific philology had not yet explained the meaning of half-forgotten Eastern tongues, literary and historical criticism was still seeking its canons, and the wildest notions passed muster as to the antiquity of Oriental books. The mutilated and misunderstood fragments of Hindu or Chinese texts paraded before the reading public were travestied on behalf, now of a traditional orthodoxy, now of an irrational denial of the popular faith. The filthy and absurd rites of later Hinduism were made to subserve the cause of the apologist, while his antagonist retorted with moral excerpts to which a fabulous age was assigned or painted an ideal portrait of Confucius and his doctrines.

Thanks to the application of the scientific method to the study of language, of history, and of society, we can now examine the historical religions of mankind calmly and dispassionately, can estimate their relative influence and importance, can trace their origin and subsequent development. We have learned the great doctrine of historical evolution. The mind of man does not move by fits and starts any more than external nature; it is conditioned by the circumstances surrounding it, and slowly grows to a ripe maturity. The various forms in which the religious emotions of man have clothed themselves, the various dogmas into which they have been crystallised, result from causes which can be discovered by careful research. The words in which they have been expressed lie like fossils in the strata of society revealing to the comparative philologist the ideas that prevailed at the time they were first coined or at the successive periods when their meaning was modified. Doctrine must necessarily develop because the mind of man develops, continually gaining new ideas and new points of view and recasting those of a past generation.

The history of doctrine may be read in the sacred books of a religion and the mode in which they have been interpreted. We see the words of the text gradually becoming fixed and sacred, and then taking upon them strange senses coloured by the beliefs and ideas of a later day. The simple utterances of an Aryan poet came to be regarded as the awful commands of the Almighty, and to constitute an infallible and irresponsible text-book of life and morals, of law and learning.

The relation of a religion, however, to its Bible may be twofold. It may have had an individual founder like the Buddha or Zoroaster, or Mohammed, and then the authority of the founder overrides that of the sacred book which derives its force and sanctity from him; or it may be the slow growth of time and circumstances, moulded, as in the case of Brahmanism, by a powerful priesthood, whose influence and dogmatic system rest entirely on the divine authority with which they have been able to invest their sacred scriptures. In the latter case a far stricter and more uncompromising theory of inspiration is necessary than in the former. To impugn a single jot or tittle of the canon is to overthrow the very foundations of the faith.

It will be a long while before the science of religion can do more than collect its facts and lay down a few broad and more or less provisional generalisations. Only when we know the way in which each of the historical religions of the world has been born and grown up, shall we be able to compare them with one another and with the unorganised religions of barbarous tribes. It has yet to be seen whether the different races of mankind have started with the same stock of religious ideas and followed similar courses of development, or whether, as has sometimes been asserted, each race has its own religion as peculiar and appropriate to itself as the colour of its skin or the character of its hair. If we may argue from the analogy of language the assertion is likely to turn out a false one.

The question of the origin of unrevealed religion cannot, of course, be answered by the study of sacred books. The early struggles of religion to clothe itself in articulate utterance lie too far behind the age of organised faith when a canon first becomes possible. An uncivilised people cannot have a Bible. It may be brought to them by others, but if so, civilisation is brought with it. To determine whether fetishism, or animism or any other "ism" was the primitive form of religion, we must look to other evidences than those presented by sacred books. Sacred books are the records of historical religions only. But it is with these records that the student of religion must begin, rather than with the fragmentary and uncertain relics of older phases of faith.

In his introduction to the first volume, Prof. Max Müller offers some useful words of warning to those who approach the study of these old texts with exaggerated ideas of Eastern wisdom and profundity. "By the side of so much that is fresh, natural, simple, beautiful, and true," there is "much that is not only unmeaning, artificial, and silly, but even hideous and repellent." The extracts culled from them by popular writers, in order to illustrate the exalted character of ancient thought, too frequently stand by the side of other passages which painfully recall the infirmities of human nature. Mankind has worked its way but slowly to its present level of knowledge and enlightenment, and the mixed character of these ancient books may serve to remind us that we, too, have our infirmities and imperfections which will seem as strange to a future generation as those of Eastern sages do to us. Man is the creature of his age, and the best and wisest among us cannot escape from the influences that surround us, and the limitations imposed by the knowledge and prejudices of our own day.

These translations will be useful in dispelling another illusion which the enthusiastic pioneers into the realm of Oriental religion have occasioned. They are as faithful and accurate as the present state of philological science allows, and the reader will, therefore, miss the modern ideas that have too often been read into passages quoted from the sacred books of the East. By changing a word here, and inserting a word there, by assimilating the expressions of the original to the familiar language of our own Scriptures, a false impression of the character of these old books has not unfrequently been produced.

The Upanishads, with which the series of translations opens may be described as the text-books of sacred Hindu philosophy. They preceded the era of the Sûtras, or grammatical treatises on the Veda, the beginning of which may be roughly placed about 600 B.C., and form part of that of the Brâhmanas or Vedic commentaries. They embody the traditional doctrines of the Brahmans regarding the highest objects of human interest and inquiry, and in many cases may be shown to have been incorporated into a Brâhmana. They aim at ascertaining the mystic sense of the Veda, and so lay the foundation of the later Hindu metaphysical systems. At the same time they are not exclusively Brahmanical; on the contrary, they seem composed rather in the interest of the Kshatriya Kings than of the priestly Brahmans. About 150 of them exist, partly in prose, partly in verse, out of which Prof. Max Müller has selected five of the most important to place before the English reader. It must be remembered that, like the Brâhmanas, the Upanishads form part of the inspired Hindu Canon.

The sacred laws of the Hindus, as taught in the schools of Apastamba and Gautama, occupy the second volume of the series. They belong to the Sûtra period of Indian literature, and we have not to read them long to discover the tyrannically Brahman spirit which they breathe. Dr. Bühler considers that the Gautama Dharmaṣastra is in the main the oldest of existing works on sacred Hindu law. He further places Apastamba at latest in the fourth or fifth century B.C. A translation of the laws taught in the schools of Vâsishṯha and Baudhâyana will follow in another volume.

The third volume contains Dr. Legge's translations of the texts of Confucianism, the Shû King, the Shih King, and the Hsiâo King. The Shû King is a collection of historical records, beginning with the reign of Yâo in the twenty-fourth century B.C., and coming down to that of Hsiang B.C. 961. The Shih King or Book of Poetry consists of 305 ancient poems, five of which belong to the time of the Shang dynasty (B.C. 1766–1123), and the rest to that of the dynasty of Châu (B.C. 1123–586). Its philological and literary value is naturally very great. The short treatise known as the Hsiâo King, or classic of filial piety, is regarded by Dr. Legge as containing a Confucian element, but mostly composed in the first century before our era. Astronomical and other reasons on the other hand, dispose him to accept the antiquity claimed by the Shû and the Shih.

Prof. Max Müller may be congratulated on the successful commencement of his great undertaking. The publication of other sacred texts, including the Korân, the works of Lao-tse, and selected portions of the Buddhist and Zoroastrian Scriptures, are expected soon to follow. For obvious reasons, however, the sacred books of ancient Egypt and Babylonia, of which we now possess considerable fragments, have been excluded from the series. The Book of the Dead, the most important part of the Egyptian Canon, will be independently issued before long in a revised text and revised translation, while we must wait for future excavations to complete the mutilated hymns of early Chaldea, a portion only of which is at present in our hands. For many years yet we shall have to be content with collecting and preparing the materials that others will use, with sowing the seed which another generation will harvest. We have, indeed, come to realise that there is a science of religion, but it will necessarily be long before the science has passed out of its firs classificatory stage.

A. H. SAYCE

MODERN CHROMATICS

Modern Chromatics, with Applications to Art and Industry. By Ogden N. Rood. International Science Series. (London: C. Kegan Paul and Co., 1879.)

IN Sir Charles Eastlake's preface to his translation of Goethe's "Theory of Colours," he took occasion to pronounce against the accepted theory of Newton (that white light consists of coloured lights compounded together), in the following sentences :—

"It must be admitted that the statements of Goethe contain more useful principles in all that relates to the harmony of colour than any that have been derived from the established doctrine. It is no derogation of the more important truths of the Newtonian theory to say that the views it contains seldom appear in a form calculated for direct application to the arts."

Since the time of Sir Charles Eastlake, however, great strides have been made in the theory of colour. The work of Prof. Rood now before us is the latest contribution to this branch of science; and in dealing with "Modern Chromatics," the author has brought to bear not merely a profound acquaintance with the work of all recent scientific writers on colour-theory, but also an intimate knowledge of the artistic and decorative functions of colour. The reproach laid against the true colour-theory of Newton that it was less fruitful for artistic ends than the false theory of Goethe, is impossible in the face of such modern works as those of Chevreul, Field, Helmholtz, Brücke, and von Bezold. And now Prof. Rood's new work will be welcomed as an addition to the literature of the subject.

The first two chapters are devoted to the general laws of light, and of its dispersion by refraction and by diffraction. Then comes a chapter on the three "constants" of colour, *purity*, *luminosity*, and *hue*, the term luminosity being employed, not as artists sometimes employ it to describe a particular "effect" of light and shade in a picture, but as the equivalent of the measurable intensity or brightness of the light. The author avoids the term "intensity" in this sense, that it may not be confounded with the term "saturation," a quality of colour which depends upon both purity and luminosity, and which is also sometimes erroneously spoken of as the "intensity" of a colour. The four following sections deal with the production of colour by interference and polarisation, by turbid media, by fluorescence and phosphorescence, and by absorption. The last of these chapters is very carefully written, and contains spectroscopic diagrams of a number of absorbing media. Their bearing upon the all-important question of the tint transmitted by two coloured media jointly is clearly explained. The remaining chapters are devoted to Young's Theory, Mixture of Colours, Complementary Colours, Colour Systems, &c. A concluding chapter deals with Painting and Decoration.

Following von Bezold, Prof. Rood rejects the term "indigo" introduced by Newton into the classification of the spectrum colours, and describes the colours between green and violet as *blue-green*, *cyan-blue*, *blue*, and *violet-blue*. The spectrum line F stands between "cyan-blue" and "blue," while "violet-blue" begins about half-way between F and G, and ends a little beyond the latter line. This classification differs slightly from that of Listing.

A detailed account is given of Maxwell's Theory of Colours, of the experiments by which he arrived at his results, and of the colour-chart devised by him. It is unfortunate, however, that the author has divided his excellent remarks on this head, giving part in an appendix to Chapter VIII., part in another appendix to Chapter XIV., and the elementary explanation of the method of balancing the colours upon p. 219 of the text. Apart from this awkward arrangement the matter is admirably put; and is the best exposition of Maxwell's theory in the language. Indeed it is singular that most English text-books ignore Maxwell's work in this department. In the English edition of Deschanel's "Natural Philosophy," which is almost the only one which touches the matter at all, the brief paragraph in which the theory is dealt with lacks the perspicacity that mostly distinguishes that well-known work.

There are one or two sentences in the work which cannot command our assent; and should be revised when another edition is called for. Thus, on p. 86, we are told that Becquerel and other earlier experimenters succeeded in obtaining fleeting photographs of the colours of the spectrum, but that "the colours thus obtained are produced merely by the *interference* of light." And again, "In blue eyes there is no real blue colouring matter *at all*" (p. 58). On p. 94 the author claims as his own an experiment described originally in this country by T. Rose, the inventor of the kalotrope. A reference is given on p. 82 to the darkening of tint of water when heated, due to increased absorption: but the author makes no reference whatever to the important observations of Gladstone, Hartley, and Ackroyd on the similar changes which take place in almost all coloured bodies when heated; nor to the significant observation of the last-named experimenter, that with increasing temperature the absorption appears to increase most in the blue end of the spectrum in the case of those solid bodies of fixed composition which expand with a rise of temperature, while it increases most at the red end for those few bodies such as iodide of silver which contract with a rise of temperature. Hering's theory of colours deserves a more extended notice than the very short note given in the final appendix. A brief account is given on p. 83 of a simple means devised by Simmler for observing the red rays which are abundantly reflected by green leaves: a thick plate of blue cobalt glass in conjunction with a plate of yellow glass serving to cut off all rays except the red and the blue-green. The writer of this notice independently described some few years ago a similar device, in which by taking a solution of permanganate of potash in a glass tank of a convenient size, the blue, green, and yellow rays were similarly absorbed, allowing only red and violet bands to pass, thus constituting, like Simmler's double plate, an erythroscope.

The portions of Prof. Rood's book which bear upon artists' work are numerous, and his observations are of importance. There is, for example, a careful discussion of the change of visible tint suffered by coloured surfaces under diminished illumination; and a parallel discussion of the results obtained by mixing pigments with a proportion of black. A list is given of those pigments which are liable to change or fade by exposure. The reason why oil colours do not materially change their tint on drying is carefully argued; and the *rationale* of Pettenkofer's "regeneration" process for picture-restoring is given. Chapter IX. sums up the indisputable evidence for regarding red, blue (or violet), and *green*, and not red, blue, and *yellow*, as the three fundamental colours, and later on is discussed the reason why a greater luminosity is obtained in mixing two colours optically, or by laying them side by side in minute touches, than is obtained by laying them over one another or by mixing them on the palette; and the author adds no less truly than concisely: "every mixture of pigments on the painter's palette is *a stride toward blackness*."

We can commend the volume to the notice of all who study colour, whether from an æsthetic or a scientific point of view. SILVANUS P. THOMPSON

OUR BOOK SHELF

Zeitschrift für das chemische Grossgewerbe. Kurzer Bericht über die Fortschritte der chemischen Grossindustrie. In Vierteljahres-heften, iii. Jahrgang. Unter Mitwirkung angesehener Technologen und Techniker. Herausgegeben von Jul. Post. (Berlin; Verlag von Robert Oppenheim, 1879.)

THIS volume is the third issue of an Annual Report of Chemical Technology in Europe and America, published in quarterly parts, the contents of each part being arranged under the following heads:—

1. Generalities and Statistics, Description of Apparatus and Machinery, Heat-production.

2. Dry Distillation of Heating and Lighting Materials, Sulphide of Carbon, Petroleum, Coal-gas, Wood-tar, Asphalte, &c.

3. Sulphur, Acids, Alkalis, Aluminium Salts, Borates, Chromates.

4. Oils and Fats, Resins, Glycerin, Volatile Oils, Lubricating Materials.

5. Sugar, Starch, Fermentation, Wine, Beer, Spirits, Vinegar.

6. Food, Meat and its Preparations, Milk and Dairy Produce, Flour and Baking.

7. Dye-stuffs, Dyeing and Calico-printing.

8. Tanning.

9. Matches and Explosives.

10. Glass, Earthenware, Cement, Plaster.

11. Metallurgy—Iron, Copper, Tin, Lead, Bismuth, Antimony, Nickel, Mercury, Silver, Gold, &c.

12. Smaller Industries—Oxalic Acid, Cellulose, Salicylic Acid, Tartaric Acid, Chloral Hydrate, Mineral Waters, Chloride of Zinc.

Detailed criticism of the immense amount of matter contained in the 900 pages of the volume is, of course, impossible. Suffice it to say that the whole has been compiled with great care; every available source of information appears to have been thoroughly ransacked; and the necessarily condensed descriptions of the several processes and products are supplemented by copious references to original papers. Lists of chemical patents taken out in Great Britain, America, France, Belgium, and Austro-Hungary, are also given at the end of each quarterly part, the whole extending to forty closely-printed pages.

In the possession of such a report of chemical industry as the one now under consideration, and of the admirable *Jahresbericht* of Dr. Wagner, the manufacturers of Germany are certainly fortunate; and when we consider the vast extent and importance of chemical manufactures in England and America, it is matter of surprise and regret that no similar work exists in the English language. Projects for such a work have, indeed, been started in this country, but their execution appears to be a problem for the future.

Southern Stellar Objects for Small Telescopes, between the Equator and 55° South Declination, with Observations made in the Punjab. By J. E. Gore, M.R.I.A., A.I.C.E., &c. (Lodiana, 1877.)

THIS small work is divided into two sections. The first contains objects arranged according to the constellations, and chiefly selected from Sir John Herschel's Cape volume, which are within the scope of telescopes of very ordinary capacity, including double stars, clusters and nebulæ, with special reference to stars which may prove to be variable. The second section contains the more original work of the author, who was provided with telescopes 3 and 3·9 inches aperture, in the Punjab, and wholly relates to southern stars possibly variable, some new and noteworthy cases being adduced.

Mr. Gore appears to have made a useful comparison of Harding's "Atlas" with the sky, so far as relates to stars found in it, which do not occur in the great catalogue from the "Histoire Céleste" of Lalande, or are underlined in the "Atlas," and it is in such cases that he has met with the most decided evidence of variability. Amongst them we may note L. 1028, a star twenty minutes due north of L. 8951, one in R.A. about 4h. 58m. for 1880, N.P.D. 111° 14′, apparently variable from 6m. to 9m.; L. 19,662 from 4·5m. to 7m.; L. 23,228; Oeltzen 17,670 (No. 31 in Mr. Gore's list), observed three times by Argelander, and estimated 5, 7, and 5·6, which is 6m. in Harding, but not in Lalande or Heis; No. 37, or Oeltzen 20363, called "a fine ruby star" by Sir John Herschel, and $6\frac{1}{2}$, and found to be only $8\frac{1}{2}$ or 9m., and fiery red with a 3-inch refractor in July, 1875, and L. 43,239. Generally, the objects mentioned in the author's second section will deserve further examination.

There is frequent reference to the magnitudes assigned in Proctor's "Atlas," by the side of those given by such original authorities as Lacaille, Heis, or even Harding; this is a mistake, and is more calculated to mislead than to assist a judgment on the question of variability. The author of this Atlas distinctly states in his preface that he has followed the magnitudes of the British Association Catalogue except for stars in Sir John Herschel's list, which is a comparatively small one; the work is more of a popular description, and so far as we know may be useful to amateurs, but it is idle to quote the indications of this Atlas with those of Argelander or Heis, whose magnitudes are the results of actual comparison with the heavens. Probably after his clear reference to the source whence his magnitudes have been derived, no one will have been more surprised to find his work quoted as an authority in a question of change of brightness of a star than Mr. Proctor himself. We should hardly have referred to this point, were it not that others have made the same mistake as Mr. Gore.

There are many misprints in this small volume, which should be avoided in another edition.

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.*]

A New Nebula

ON November 14, the Rev. T. W. Webb discovered a small nebula, or nebulous star, in Cygnus. It is apparently identical with D.M. + 41, No. 4004, 8·5m.

1880 = 21h. 2m. 31s. + 41° 45′·3.

At Dunecht Observatory the object was seen, on November 22 and 23, to be approximately monochromatic, seen through passing clouds; about 5″ diameter. LINDSAY

Dunecht Observatory, November 24

Does Sargassum Vegetate in the Open Sea?

THE reply of Dr. Wild in NATURE, vol. xx. p. 578 to my query, does not satisfy me, for he partly cites old reports, that are, as I showed, mostly suspicious of being a mixture of the prevalent opinion since Columbus and observed facts.

If it has been stated formerly that pelagic varieties (?) multiply only by simple growth and subdivision, and a wide area covered with sea-weeds corresponding to the Sargasso Sea occurring in the North Pacific, I believe that is only a compilation. I crossed the Pacific Sargasso Sea (as it is printed on the charts) in December, 1874, from 140° W. long., 35° N. lat., to 174° W. long., 29° N. lat., and observed no Sargassum at all! But it is possible that the quantity differs in different years. I ask, therefore—and beg for personal observations only—has any one seen a difference in the quantity or density of floating Sargassum in different years, and in what degree or quantity has (1) brownish or olive-coloured, and (2) yellowish pale Sargassum been seen in several years?

A flowering branch with buds of any garden plant, if cut and put into water, does not wither suddenly, but sometimes opens continuous to the buds, and may even sprout, but never for a long time; but we never call such cut flowering branches put into a water-glass water plants. I take Sargassum to be analogical, and it should not be allowed to consider the dying broken Sargassum or Fucus, that swing in the open sea, as pelagic in habit, or as a living variety of the open sea.

If it has been stated that the last branches of floating Sargassum are paler, more delicate, and more active in their vitality; I believe that to be no real observation, but only a supposition, for the more delicate and more branched ends become certainly pale at first, and with the diminution of chlorophyll can never increase their vitality. Does any one know in what time the olive-coloured broken Sargassum gets pale, and if pale Sargassum does really sprout to some extent, which I doubt, how long it continues to sprout? and further, after what time do the dead round air-vesicles of Sargassum break off? I should wish these questions cleared up by personal observations.

Leipzig-Eutritzsch, Germany OTTO KUNTZE

Remarkable Prediction of Cold

IN NATURE, vol. xxi. p. 48, in the Meteorological Notes, it is stated, on the authority of Mr. Glaisher, that the present unusually cold weather set in on October 27, 1878. You perhaps are not aware that this was predicted almost to the day by Prof. Piazzi Smyth in NATURE, vol. v. p. 317. In an article on Heat Waves he gives the dates of these phenomena as follows:—Years 1834·8, 1846·4, 1857·8, 1868·8, and 1880·0; the heat wave of 1880 to be preceded by a cold wave commencing 1878·8, which is, I need scarcely say, the end of October, 1878.

Dulwich, November 17 B. G. JENKINS

The Lizard

LAST August, while superintending the burning of some dry bush in my pasture, I was surprised to see a ground lizard (*Lacerta agilis*) run up to the flames and stop on a bed of hot ashes. My little son who was with me endeavoured to turn it aside with a stick, but on his trying to do so, it darted into the fire and was soon consumed. This I thought at the time accidental, but later in the day we returned to the same spot, and in a few minutes a larger lizard of the same species deliberately ran up to the burning bush; it paused on the warm ashes wagging its tail to and fro, apparently enjoying the heat, when all of a sudden it darted into the flames, and like the first one was instantly a willing holocaust. I turned to the Negro, who was burning the bush, for explanation, but like most of his race he accepted the fact as a matter of course, remarking "lizard seem to love fire." My ideas went back to the legends of the salamander. The story of the French consul at Rhodes (M. Pothonier), who one day found his cook in a terrible fright thinking the "devil was in the fire," and when he looked into the bright flames, saw there a little animal with open mouth and palpitating throat, and on trying to secure it with the tongs, it ran into a heap of hot ashes. He secured it and gave it to Buffon, who found it to be a small lizard, whose feet and a portion of the body were half roasted. M. Pothonier first thought it was incombustible, having remained in the fire three minutes, but imagined that it might have been brought in with the fuel. Nicander, Dioscorides and Pliny, all allude to the fire-proof qualities of the "salamandra." Aristotle speaks of the salamandra's power of extinguishing fire with the copious secretion of saliva which it has the power of ejecting into the flames. As far as my own observation goes all lizards have the power of ejecting saliva. The Negroes have a dread of the croaking lizard's (*Gecko*) "spitting" at them. I do not believe that any Jamaica lizard has *poisonous* saliva, but that the saliva is deleterious, I am quite sure. That cats get "fits" from eating lizards is a well accepted fact, their *hair* falls out, and they become sick and droop, confirming the belief in the depilatory properties of the salamander's saliva. As Martial puts it (Lib. ii. Ep. lxi.):—

"Desine jam, Lalage, tristes ornare capillos,
Tangat et insanum nulla puella caput.
Hoc salamandra notet, vel sæva novacula nudet,
Ut digna speculo fiat imago tuo."

Before closing these jottings, I should like to correct an error in a recent work on Natural History, in which it is stated that "the *Iguana is extinct in Jamaica*." This is *not* the case. They are still to be found in numbers on the Cashew trees in the lowlands, especially St. Catherine's. I once had a long fight in trying to pull a large one out of a hole in a tree, by the tail. He won the battle "by the skin of his tail."

Monattrie, St. Andrew, Jamaica, W.I., JASPER CARGILL
October 14

The "Hexameter," Πᾶσα δόσις ἀγαθή . . . κ.τ.λ.

IT is surely no argument against Prof. Clerk Maxwell's notion, that in the epistle (James i. 17) the enclitic particle τε is omitted. Read, of course,

Πᾶσα δόσις τ' ἀγαθὴ καὶ πᾶν δώρημα τέλειον,

and the verse is perfect. The practice of omitting a word (or part of a word) necessary to the scansion of a verse is all too common with prosists quoting poetry. I give one example from an English writer. Robert Greene, the earliest to allude to Shakespeare, in his "Groatsworth of Wit bought with a Million of Repentance" (1692), quotes, just as if they were prose, six lines from a contemporary poet; and in so doing inserts two words and omits two and part of another! He writes, as prose, omitting all that I here give in italics—

"*Then* onely Tyrants should possesse the earth,
Who striving to exceede in tyranny,
Should each to other bee a slaughter-man;
*Un*till the mightiest outliving all,
One stroke were left for Death, that in one age
Man's life should ende."

I am pleased to learn from the obituary notice in NATURE of that great man, that Clerk Maxwell's thoughts during his illness reverted to a play of Shakespeare's; but had he less profitably thought of Greene's assault on Shakespeare, and had it struck him that the foregoing must be in heroic verse, what would be thought of the critic who should object to this, that the first and fourth of these so-called verses are, by one syllable each, too short?

Athenæum Club, November 22 C. M. INGLEBY

IT cannot be supposed that our translators meant to compose a verse when they wrote the line which Longfellow transfers bodily into his "Evangeline":—

"Husbands, love your wives, and be not bitter against them."

So the metrical cadence here may be quite accidental. Still I cannot think that the defect of quantity in the final syllable of δόσις is fatal to the idea that it may be a line from an early Christian doxology: especially when we suppose it written in Alexandrian or Hellenistic Greek. The arsis, or natural stress of the voice, would cover up the defect, especially in chanting; and it would scarcely be a defect at all to non-classical ears. The process which rapidly from the Christian era substituted stress or accent, as we now understand it, for quantity, seems to have been greatly accelerated by the hymns of the Church. In any case every trace of such quotations is of great interest to every student of the New Testament. HENRY CECIL

Bregner, Bournemouth, November 22

Unconscious Cerebration

I HAVE delayed noticing a communication, headed Unconscious Impressions, by Mr. C. J. Monro, in NATURE, vol. xx. p. 426. This refers to what Dr. Carpenter calls Unconscious Cerebration, but which when I discovered it likewise, I called Unconscious Thought.

With Mr. Monro's conclusion that an unconscious impression is stronger than a conscious one, his statement does not impress me, nor is it supported by my own experience.

My attention had been recalled to the subject by observing children, and in their actions it appears to me we may find the beginning of the process of unconscious cerebration. So far it appears that conscious cerebration precedes and lays the foundation for the unconscious process. When a baby is practising, as for instance in handling an object, its attention is closely given in the early stages and in its various experiments, and it is only after a time that the performance becomes purely mechanical.

The same is to be noted of young animals.

Hence I conclude that as various practices become habitual, and, as some style them, instinctive, conscious cerebration ceases to be employed. Thus is formed the habit of only regarding some objects consciously, and necessarily that of regarding others without cerebration. Thus I treat unconscious cerebrations as becoming habitual. HYDE CLARKE

32, St. George's Square, S.W., November 20

Mr. Thomas Bolton's Natural History Discoveries

I ONLY became aware on Saturday evening last, the 15th inst., of the paragraph kindly inserted by Prof. E. Ray Lankester, F.R.S., as editor, in the *Quarterly Journal of Microscopical Science* for October, in reference to my studio and agency for the supply of microscopic organisms. Of course I have to thank him most sincerely for calling the attention of naturalists to my efforts, and so strongly calling on them to support me, but he has given me credit in some directions which is due to other naturalists to whom I am under considerable obligations. I wish to correct this view at once by writing to your periodical in preference to waiting till the next number of the *Quarterly* can appear. Prof. Lankester's language may lead those who have not seen other reports to put down the actual first finding of several organisms new to the British fauna to me, whereas several of them were first picked up by others.

The *Leptodora* was found at Olton during a visit made by a party of the Birmingham Natural History and Microscopical Society on July 26. Whilst the president, Mr. Graham, the curators, Messrs. Levick and Lloyd, some other members, and myself, were searching the pool from a boat, Mr. Levick's unusually sharp eyes first called the attention of the others to some lively organism in his bottle, which he at first thought to be a larva, and Mr. Graham was, I believe, the first to suggest that it was probably a larval form of an Entomostracan. After this they were collected in large numbers with the net. As soon as possible I asked my friend Mr. Forrest to make a drawing, which I had printed, and drew up a short account of it for my subscribers, describing it as a larval form of one of the Entomostraca; but before I had finished writing this I found one carrying four large eggs in the second segment of the body, which fact I added to my description, and which I pointed out would lead to the supposition that it was no larva, but a mature animal. I sent the specimens out on August 1, and the earliest notice I had from my subscribers was from Sir John Lubbock, F.R.S., who wrote by return to say he was much interested in the curious crustacean which he believed to be new to this country, and on August 6 Prof. Lankester wrote to say the crustacean I had sent was the *Leptodora hyalina*. In looking over the water in which we had taken the Leptodora, I found another Entomostracan which was new to me, and I called Mr. Forrest's attention to it, and gave him some specimens which he took home and studied, and finding no trace of them in Baird's "Entomostraca," he made a drawing of it and drew up a description of it for the *Midland Naturalist* of September, under the name of *Daphnia bairdii*. With permission of the editor I distributed copies of this plate and description, with living specimens, to my subscribers on August 8, and on the 13th Prof. Lankester wrote me to say "the beautiful *Daphnia bairdii* of Mr. Forrest is the already described *Hyalodaphnia kahlbergensis* of Schödler" (see Mr. Forrest's further remarks, *Mid. Nat.*, November, page 281). In looking over Prof. Lankester's remarks, I was surprised to see his account of the new Protozoon, which reminded me that on April 30 he had written to me saying that the Amœbæ gathering was very interesting, and asking me to send him a good lot more, as he thought he had found something new, but I could only send him a small tube more, as this, together with the large Amœbæ to which he refers, came from a small beaker aquarium in the study of my friend Mr. Levick.

I must apologise for having taken up so much of your space, but in fairness to Mr. Levick and Mr. Forrest, I could not well let the report pass without comment, giving them full credit of first finding the objects; but at the same time I cannot help thinking that the discoveries (if ever published) would have been much longer before they had been brought before the scientific world, had it not been for the distribution of the specimens through my agency. As it is, however, my wish not to take more credit than is due, I shall always be glad to point out the first finders of organisms which may be entrusted to me for distribution, and which may *afterwards* turn out to be of any special interest.

In furtherance of Prof. Lankester's kind appeal to naturalists for the pecuniary support of my agency, I must really ask them to act upon it, as, so far, my studio is not sufficiently remunerative to induce me to persevere with it much longer, as my receipts for the last year have barely covered my office rent, collecting, and incidental expenses.

THOMAS BOLTON

17, Ann Street, Birmingham, November 19

Intellect in Brutes

THE following is a curious instance of discrimination, which I have observed in my bullfinch. He is in the habit of coming out of his cage in my room in the morning. In this room there is a mirror with a marble slab before it, and also a very cleverly-executed water-colour drawing of a hen-bullfinch, life-size. The first thing which my bullfinch does on leaving his cage is to fly to the picture (perching on a vase just below it), and pipe his tune in the most insinuating manner, accompanied with much bowing to the portrait of the hen-bullfinch. After having duly paid his addresses to it, he generally spends some time on the marble slab in front of the looking-glass, but without showing the slightest emotion at the sight of his own reflection, or worthying it with a song. Whether this perfect coolness is due to the fact of the reflection being that of a cock-bird, or whether (since he shows no desire to fight the reflected image) he is perfectly well aware that he only sees himself, it is difficult to say.

SOPHIE FRANKLAND

"Asia Minor" in the "Encyclopædia Britannica"

IN the article on "Asia Minor" in the new edition of the "Encyclopædia Britannica," in speaking of Tchihatcheff's "Asie Mineure," the writer says: "But those [vols.] which should have contained the geology and the archæology have never been published." As this may mislead some of your readers it may be worth recording the fact that the part on geology was published in 1867-69; and the palæontological division in 1866-69.

J. B. B.

Oxford

ON THE SOLUBILITY OF SOLIDS IN GASES[1]

THIS investigation was undertaken in the hope that, by an examination of the conditions of liquid matter up to the "critical" point, sufficient knowledge might be gained to enable us to determine under what particular conditions liquids are dynamically comparable, in order that the microrheometrical method[2] (which the Royal Society has done one of us the honour of publishing in the *Philosophical Transactions*) might be applied to determine their molecular mass and energy relations. It seemed that as the laws relating to gases and liquids merge at what was called by Baron Cagniard de la Tour[3] "l'état particulier," and by Dr. Andrews[4] the "critical point," an examination of matter up to the limit of the liquid state would be likely to yield us much information. The time we have to devote to scientific work being very limited, we found that it was quite impossible to make much advance by using the apparatus devised by Dr. Andrews, as the time required to change from one liquid to another was more than we had at our disposal. We therefore devised a new apparatus, which will be described in a more lengthy communication, but which, we may state, can be opened, the liquid changed, and again closed for a new experiment, in about one minute.

The question as to the state of matter immediately beyond the critical point being considered by Dr. Andrews to be at that time incapable of receiving an answer, we imagined that some insight might be gained into its condition by dissolving in the liquid some solid substance whose fusing point was much above the critical point of the liquid, and noticing whether, on the latter passing its critical point and assuming the gaseous condition, the solid was precipitated or remained in solution. We found that the solid was not deposited but remained in solution, or rather in diffusion, in the atmosphere of vapour, even when the temperature was raised 130° above the critical point, and the gas was considerably expanded. When the side of a tube containing a strong gaseous solution of a solid is approached by a red hot iron, the part next the source of heat becomes coated with a crystalline deposit which slowly redissolves on allowing the local disturbance of temperature to disappear. Rarefaction seems to be the cause of this deposition, because if

[1] By J. B. Hannay, F.R.S.E., F.C.S., and James Hogarth. Read at the Royal Society, November 20.
[2] "On the Michrorheometer," *Phil. Trans.* Roy. Soc., 1879.
[3] *Ann. Chim.*, series 2me, xxi. p. 127; xvii. p. 410.
[4] "Bakerian Lecture," *Phil. Trans. Roy. Soc.*, 1869, p. 588.

the temperature be raised equally and the volume retained at its original value, no deposition takes place. Those experiments have been done with such solvents as alcohol (ethyl and methyl), ether, carbon disulphide and tetrachloride, paraffins, and olefines, and such solids as sulphur, chlorides, bromides, and iodides of the metals, and organic substances such as chlorophyll and the aniline dyes. Some solutions show curious reactions at the critical point. Thus ethyl alcohol, or ether, deposits ferric chloride from solution just below the critical point, but re-dissolves it in the gas, when it has been raised 8° or 10° above that temperature.

It appeared to us to be of some importance to examine the spectroscopic appearances of solutions of solids when their liquid menstrua were passing to the gaseous state, but as all the substances we have yet been able to obtain in the two states give banded spectra with nebulous edges, we are only able to state that the substance does not show any appreciable change at the critical point of its solvent. Such was the case with anhydrous chloride of cobalt in absolute alcohol. It was suggested to us by Prof. Stokes that the substance obtained by the decomposition of the green colouring matter of leaves by acids, and which yields a very fine absorption spectrum, might be useful for our purpose. We have prepared the substance according to the careful directions so kindly furnished us by Prof. Stokes, and find that it shows the phenomenon in a marked manner, whether dissolved in alcohol or ether. The compound is easily decomposed by heat under ordinary circumstances, and yet can be dissolved in gaseous menstrua, and raised to a temperature of 350° without suffering any decomposition, showing the same absorption spectrum at that elevated temperature as at 15°.

We considered that it would be most interesting to examine by this method a body such as sodium, which, besides being an element, yields in the gaseous state sharp absorption lines. An opportunity seemed to be afforded by the blue solution of sodium in liquefied ammonia, described by Gore,[1] but we found that, on raising the ammonia above its critical point, the sodium combined with some constituent of the gas, forming a white solid, and yielding a permanent gas, probably hydrogen.

There seems, in some cases, to be a slight shifting of the absorption bands towards the red, as the temperature rises, but we have as yet been able to make no accurate measurements.

When the solid is precipitated by suddenly reducing the pressure, it is crystalline, and may be brought down as a "snow" in the gas, or on the glass as a "frost," but it is always easily redissolved by the gas on increasing the pressure. These phenomena are seen to the best advantage by a solution of potassic iodide in absolute alcohol.

We have, then, the phenomenon of a solid with no measurable gaseous pressure, dissolving in a gas, and not being affected by the passage of its menstruum through the critical point to the liquid state, showing it to be a true case of gaseous solution of a solid.

Private Laboratory, Sword Street, Glasgow

ON PHOTOGRAPHING THE SPECTRA OF THE STARS AND PLANETS[2]

FOR many years it has seemed probable that great interest would be attached to photographs of the spectra of the heavenly bodies, because they offer to us conditions of temperature and pressure that cannot be attained by any means known at present on the earth. The especial point of interest is connected with considerations regarding the probable non-elementary nature of the so-called elementary bodies. There has long been a suspicion in the minds of scientific men that one or more truly elementary bodies would be found from which those substances which have not as yet been decomposed are formed. The recent publications of Lockyer have attracted particular attention to this topic.

The most promising laboratory processes for accomplishing the dissociation of our present elements depend upon the action of heat, especially when accompanied by electrical influences, and upon relief of pressure. But the temperature we can employ is far below that found in the stars, which is comparable only with the heat of our sun, and when in addition the application of heat is restricted by the narrow range of circumstances under which we can also reduce the pressure, complete success seems to be impracticable in the laboratory.

But in the stars, nebulæ, and comets, there is a multitude of experiments all ready performed for us with a variety of conditions of just the kind we need. It remains for us to observe and interpret these results, and this is the direction I have sought to pursue.

There is but one mode of investigation that can add materially to the knowledge astronomy has given us of the heavenly bodies—that is the spectroscopic. This in its turn is capable of a subdivision into two methods, one by the eye, the other by photography. Each of these has its special advantages and each its defects. The eye sees most easily the middle regions of the spectrum, and can appreciate exceedingly faint spectra; by the aid of micrometers it can map with precision the position of the Fraunhofer lines, and by estimation it can with tolerable accuracy approximate to the relative strength, breadth, and character of these lines. The character of the spectrum lines is, however, of great value for the purposes we are now speaking of, and the greatest precision is needed. Photography, on the other hand, as applied to faint spectra, deals mainly with the more refrangible region, and cannot at present be employed in stellar work below the line F. Fortunately there is no break in the spectrum between the place where the eye leaves off and photography begins, and hence the two methods lend one another mutual assistance. The photograph, when suitably accommodated with a standard reference spectrum from some known source, gives valuable indications as to the positions and all the peculiarities of the lines.

But the application of photography to the taking of stellar spectra is surrounded by obstacles. These are partly due to the small quantity of light to be dealt with, and partly to the fact that it is necessary to overcome the motion of the earth and other causes, such as atmospheric refraction, which seem to make a star change its place continually. The exposures of the sensitive plate require to be sometimes for two hours, even with a large telescope; and if during that time the image of the star at the focus of the telescope has changed place $\frac{1}{300}$ of an inch, the light no longer falls on the slit of the spectroscope. The changes of the earth's atmosphere in regard to photographic transparency, as well as by fog, also offer impediments and promote the chances of failure. There is often a yellow condition of the air, which may increase the length of exposure required forty times or more.

It will, from what has been said above, be readily perceived that a research such as this consumes a great deal of time; in fact, these experiments and the preparations for them have extended over more than twelve years. A large telescope is required, and for many reasons the reflector at first seems most suitable. Recently, however, I have found that the refractor has also some special advantages.

In 1866 I had already constructed a silvered glass reflector of 15½ inches aperture, which was commenced in 1858, and had taken with it many hundreds of photographs of the moon. But as the mounting had been

[1] *Proc. Roy. Soc.*, vol. xxi. p. 145.
[2] Read before the National Academy of Sciences, October 28, by Henry Draper, M.D.

contrived for lunar photography and to avoid the moon's motion in declination, the instrument was not suitable for the spectroscopic work contemplated. A reflector of 28 inches aperture was therefore commenced in 1866, and in 1871 it was ready for use.

On May 29, 1872, my first photograph of the spectrum of a star was taken, the spectrum of Vega being photographed by the aid of a quartz prism. At this time I did not happen to know that Dr. Huggins, who is so distinguished for his thorough and accurate researches on the visible portion of the spectra of the heavenly bodies, had already made some attempts in this direction, as is shown by the following paragraph from the *Transactions* of the Royal Society for 1864:—"On the 27th of February, 1863, and on the 3rd of March of the same year, when the spectrum of Sirius was caused to fall upon a sensitive collodion surface, an intense spectrum of the more refrangible part was obtained. From want of accurate adjustment of the focus, or from the motion of the star not being exactly compensated by the clock movement, or from atmospheric tremors, the spectrum, though tolerably defined at the edges, presented no indications of lines. Our other investigations have hitherto prevented us from continuing these experiments farther, but we have not abandoned our intention of pursuing them."

During August, 1872, I took several photographs of the spectrum of Vega, and these showed four strong lines at the more refrangible end of the spectrum, the least refrangible being near G. On pursuing the subject and seeking to ascertain what substances gave rise to these lines, it became obvious that a photographic study of this part of the spectrum for the metals and non-metals was necessary to interpret the results. This, of course, opened out a large field for experiment, requiring many years for its study, and hence, as several physicists were engaging in the study of the spectra of the metals, I concluded to discontinue the experiments commenced in 1870 on the spectra of the metals and to confine the investigation mainly to the non-metals. The initial step was, however, to obtain a fine photograph of the normal solar spectrum, so that the wave-lengths of the lines up to O [wave-length 3440] might be determined with precision.

In the spring of 1873 I published a paper on the diffraction spectrum of the sun, illustrated by a photograph embracing the region from wave-length 4350, near G, to 3440, near O, and in the fall of the same year took photographs of the spectra of several non-metals, notably nitrogen, carbon, and oxygen. The experiments were interrupted, in the spring of 1874, by going to Washington to superintend the photographic preparations for the United States observations on the transit of Venus.

Since that time my experiments have been divided into two parts, an astronomical portion occupying principally the summer season, and a laboratory portion during the rest of the year. The former consisted of photographs and observations on the spectra of the stars, planets, and sun; the latter of photographic work on the spectra of the elements, and particularly the non-metals, and has led to the discovery of oxygen in the sun.

In 1876 Dr. Huggins published a note in the *Proceedings* of the Royal Society, accompanied by a woodcut of the spectrum of Vega, with a comparison solar spectrum. Seven lines were observed in the spectrum of Vega. In the summer and autumn of 1876 I made several photographs of the spectra of Vega, α Aquilæ, and Venus, and sent a note concerning them to the *American Journal*.

Since that time Dr. Huggins has pursued the subject actively in spite of the London atmosphere, and has attained very fine results, which I had the pleasure of seeing at his observatory last spring. These he is preparing to publish shortly. In my observatory photographs have been taken of the spectrum of Vega, Arcturus, Capella, α Aquilæ, Jupiter, Mars, Venus, the moon, &c. Recently the plan has been to have a comparison solar spectrum on every plate, derived either from the diffused light of our atmosphere or from the moon or from Jupiter. In this way no difficulty in determining the wave-lengths of the lines is encountered, and the changes produced by our atmosphere are eliminated. The telescope and spectroscope are now in good working order, but to secure the requisite degree of precision of movement it has been necessary to make seven different driving-clocks before a satisfactory one was attained.

It has been remarked that on account of the faintness of the light of stellar spectra, prolonged exposures of the sensitive plate are required. In former times, when the dry processes of photography were much less sensitive than the best wet plates, the exposure was limited by the length of time the plate could be left in the camera without being stained by drying. But now, since the gelatino-bromide process has been introduced, this obstacle has been removed and a sensitive plate is sometimes exposed two hours to the spectrum of a star and then almost an hour to Jupiter for the comparison spectrum. The best, and most sensitive, gelatine plates I have used are those made by Wratten and Wainwright, of London; Dr. Huggins was good enough to call my attention to them.

It is not worth while to describe the various forms of spectroscope that have been employed in the last ten years; quartz, Iceland spar, hollow prisms and flint glass have been the materials, and they have been sometimes direct vision and sometimes on the usual angular plan. Gratings on glass and speculum metal given to me by Mr. Rutherford have been tried. The length of spectroscope has been sometimes 28 feet and sometimes not as many inches.

The especial spectroscope for stellar work that is now on the telescope is intended to satisfy the following conditions: (1) to get the greatest practicable dispersion with the least width of spectrum that will permit the lines to be seen; (2) to use the entire beam of light collected by the 28-inch reflector or 12-inch achromatic without loss by diaphragms; (3) to permit the slit to be easily seen so that the star may be adjusted on it; (4) to avoid flexure or other causes that might change the position of the spectrum on the sensitive plate in pointing the telescope first on one and then on another object; (5) to admit of observing the spectrum on the sensitive plate at any time during an exposure without risk of shifting or disarrangement. The dispersion is produced by two heavy flint prisms which are devoid of yellow colour; the telescopes are about 6 inches in focal length, and the slit has a movable plate in front of it, enabling the operator to uncover either the upper or the lower portion at will.

During the past summer this spectroscope has been used with the Clark refractor of 12 inches aperture, partly because the 28-inch reflector has been kept unsilvered since it was used in taking photographs of the transit of Mercury, on account of its employment in certain experiments on the sun. Moreover, there is an advantage possessed by the refractor for this work which does not appear at first sight. Naturally one supposes that a reflector which brings all the rays from the star, no matter what their refrangibility, to a focus in one plane, would be best, because when the slit is put in that plane it is equally illuminated by rays of all refrangibilities, and the spectrum will be parallel-sided in its whole length. On the other hand a refractor is not achromatic, for the violet end of the spectrum comes to a focus either inside or outside of the plane of the rays in the middle of the spectrum, and in observing the spectrum it is not parallel-sided. This peculiarity was used by Mr. Rutherford to enable him to correct a telescope lens for the ultra-violet rays. It is easy, therefore, with a refractor, so to adjust the position of the slit that you may have a spectrum tolerably wide at F and G, and which gradually diminishes in width towards H, and finally becomes linear at M. Now as the effect of atmospheric absorption on the spectrum increases as you pass from G toward H and above H, by diminishing the width of the spectrum you can in some measure neutralise the effect, and at one exposure obtain a photograph of nearly uniform intensity from end to end, though it is of variable width. If it were not for this it would be necessary to have the spectrum over-exposed at G in order to be visible above H, or else to resort to an elaborate diaphraghming which is difficult.

It is my intention next season to return to the use of the 28-inch reflector, because it collects nearly five times as much light as the 12-inch does, after making allowance for the secondary mirror. Of course in a large reflector the difficulties of flexure and instability of the optical axis are much increased, and keeping a star on the slit will be troublesome, especially as the magnifying power on the image is about 50.

As to the results obtained, it has already been mentioned that the spectra of several stars and planets have been photographed. The subject of planetary spectra will be reserved for a future communication. A preliminary examination at once shows that these stellar spectra are divisible into two groups: (1) those closely resembling the solar spectrum, and (2) those in which there are relatively but few lines, and those of great breadth and intensity. The photographs of the spectra of Arcturus and Capella are so similar to the solar spectrum, that I have not up to the present detected any material differences. But, on the other hand, the spectra of Vega and α Aquilæ are totally different, and it is not easy without prolonged study and the assistance of laboratory experiments to interpret the results, and even then it will be necessary to speak with diffidence. I have not as yet obtained any stellar spectrum photographs belonging to the third and fourth groups of stellar spectra as described by Secchi. These, if obtainable, will aid materially in discussing the whole subject, but unless a star passes near the zenith it is hard to make a fair study of its spectrum by photography, because atmospheric absorption in the ultra-violet region increases rapidly as the altitude decreases. In the case of the sun I have found that at sunset the exposure necessary to photograph the spectrum above H, is often 200 times as long as at mid-day.

In the case of the spectrum of Vega, when examined by the eye, the lines C, F, near G and *h*, are readily visible, but lines such as D and *b* are relatively faint. It is clear, then, that hydrogen exists to a large extent in the atmosphere of that star. But on examining the photograph of its spectrum it is evident that other lines just as conspicuous as the hydrogen lines, are present. One of these corresponds in position and character to H_1, and seems to coincide with a calcium line. It appears to me, however, that the evidence of this coincidence is not complete.

In attempting to reason from these photographs as the matter now stands, it is necessary to try at every step farther experiments in order to find out whether the facts agree with the hypothesis, and it is this very condition of affairs that gives hopes of results valuable in their bearing on terrestrial chemistry and physics. In the photographs of the spectrum of Vega there are eleven lines, only two of which are certainly accounted for, two more may be calcium, the remaining seven, though bearing a most suspicious resemblance to the hydrogen lines in their general characters, are as yet not identified. It would be worth while to subject hydrogen to a more intense incandescence than any yet attained, to see whether in photographs of its spectrum under those circumstances any trace of these lines, which extend to wave-length 3700, could be found.

It is to be hoped that before long we may be able to investigate photographically the spectra of the gaseous nebulæ, for in them the most elementary condition of matter and the simplest spectra are doubtless found.

THE FUNCTION OF CHLOROPHYLL

THE Report of the Berlin Academy for July last contains a remarkable paper by Prof. Pringsheim on this subject. In pursuing his researches upon chlorophyll, he had found that positive results could only be obtained by employing *intense* light, and in this paper he gives some account of the conclusions at which he has been enabled to arrive by the use of this method.

By means of a heliostat and a strong lens, the object to be observed under the microscope is brightly and constantly illuminated; the effects of this illumination, which are striking, are produced in a few (3-6) minutes. Assuming that the object contains chlorophyll-corpuscles, the first visible effect is the rapid disappearance of the green colour, so that the object appears as if it had been lying for some days in alcohol, the corpuscles retaining however their form and consistence. Changes now gradually become apparent in the protoplasmic cell-contents; the circulation of the protoplasm, where it exists, is arrested; the bridles of protoplasm rupture, and the nucleus is displaced; the ectoplasm contracts, becomes permeable to colouring-matters, and the turgidity of the cell disappears; the cell presents, in fact, all the symptoms of death.

It seems natural to suggest that these effects may be due, to some extent at least, to the action of the high temperature to which the cell is exposed under these conditions. Prof. Pringsheim, anticipating this criticism, is careful to point out that they are produced by all the different parts of the visible spectrum. They are quite evident when the light has previously passed through a solution of iodine in carbon disulphide, but they are more distinct when the light has passed through an ammoniacal solution of cupric oxide; the light to which the object is exposed consisting, in the former case, of red rays, in the latter, of blue and violet. Moreover, if the solution of iodine be so concentrated that only the rays of a greater wave-length than 0·00061 m.m. can pass, these effects are not produced although about eighty per cent. of the heat is transmitted; on the other hand, if the ammoniacal solution of cupric oxide be so concentrated that the whole of the rays of low refrangibility to a wave-length of 0·00051 m.m. are absorbed, the effects are rapidly and vividly produced, although the amount of heat which passes is comparatively small. From these facts he concludes that the phenomena in question are the results not of the action of heat, but of that of light.

This important point being settled, he proceeds to determine in what manner this action of the intense light is affected by the atmosphere in which the object exists. As the result of a variety of experiments he finds that these effects are only produced when the atmosphere contains oxygen.

These are very briefly the facts which Prof. Pringsheim has ascertained by this method; we will at once pass to the consideration of the conclusions which he draws from them. He concludes, in the first place, that the decomposition (oxidation) of chlorophyll in the living plant is a process of combustion which is influenced and promoted by the action of light, and which stands in no relation to the decomposition of carbonic acid by the plant. Since the green colour of the chlorophyll-corpuscles which have become blanched is not subsequently restored, even though the cell continue to live, it appears that this oxidation of the chlorophyll is not a normal physiological occurrence, but that it is purely pathological. Prof. Pringsheim was unable to find any substance in the cells which might be regarded as the product of the oxidation of the chlorophyll, neither could he detect any increase of the fat or starch in the blanched cell, nor the formation of grape-sugar or dextrin : he therefore concludes that the products of the oxidation of the chlorophyll are given off in the gaseous form. In the second place he concludes that the changes produced in the protoplasmic cell-contents are the direct effects of the photochemical action of light. That they are not due to the presence of the products of the decomposed chlorophyll is shown by the fact that they may be observed equally well in cells which do not contain chlorophyll, such as the stinging-hairs of the nettle, &c. This being the case, he infers that they too are produced by a process of combustion. The final conclusion to which he comes is that chlorophyll exercises a protective influence over the protoplasmic cell-contents by absorbing the actinic rays of the spectrum, thus diminishing the combustion (respiration) going on in the cell ; that it is in fact the regulator of the respiration.

In another series of experiments Prof. Pringsheim endeavours to determine what are the substances which become oxidised in the process of respiration. He finds in all chlorophyll-containing cells, a substance which can be best extracted by immersing the parts—leaves for instance—in dilute hydrochloric acid for several hours. This substance, to which he gives the name of hypochlorin or hypochromyl, is of an oily nature; it is probably a hydrocarbon which consists only of carbon and of hydrogen, or one which contains oxygen also in its molecule, but in smaller proportion than the carbohydrates ; it is soluble in alcohol, ether, turpentine, and benzol, but insoluble in water and in solutions of neutral salts ; it occurs in long, red-brown, crystalline needles which soon harden after extraction, into an imperfectly crystalline mass of resinous or waxy consistence. It is readily oxidisable, as is shown by the fact that it disappears from the cell on exposure to intense light in an atmosphere containing oxygen, even sooner than the chlorophyll. Prof. Pringsheim is of opinion that this substance is the first product of the assimilation of the chlorophyll-corpuscle, and that starch and oil are subsequently formed from it by oxidation.

Applying these views to the life of the cell under ordinary conditions, the changes going on in the cell when exposed in the air to sunlight would be somewhat as follows : the general protoplasm would undergo some amount of oxidation, but not so much as to materially diminish its quantity or affect its properties; in the chlorophyll-corpuscles, oxidation would be either entirely arrested in consequence of the absorption of the actinic rays by the green colouring-matter, or at least so much diminished that the synthesis of the elements of water and carbonic acid to form hypochlorin could take place.

Since this paper is stated to be a merely provisional account of these very interesting experiments, it is hardly fair to submit it to a detailed criticism : it will be better to wait until the publication of the more complete account which Prof. Pringsheim promises in an early number of his *Jahrbücher*. All that will be attempted at present is to indicate some of the principal difficulties which beset the acceptance of these new views. For instance, exception may be taken to the view that chlorophyll, when exposed to intense light is oxidised into gaseous bodies. It is well known that an alcoholic solution of chlorophyll, when exposed to sunlight in the presence of air, becomes oxidised and assumes a pale yellow colour ; it may be that this also takes place in the chlorophyll-corpuscles, the yellow colour being hardly distinguishable on account of the smallness of the quantity which is present. Again, it will doubtless have occurred to every reader of this paper that hypochlorin may be nothing more than the wax which has long been known to exist in considerable quantity in chlorophyll-corpuscles. But the main difficulty has reference to the protective functions which Prof. Pringsheim ascribes to chlorophyll. Admitting that the changes described above as occurring in the protoplasmic cell-contents are really the results of excessive oxidation consequent upon exposure to the intense light, it is evident that they are effected less quickly than the oxidation of the chlorophyll itself; that is to say that, *ceteris paribus*, the chlorophyll is more readily oxidised than the protoplasm. This being the case, it is not easy to understand how the former can efficiently protect the latter from the oxidising influence of light and regulate its respiration. This difficulty might perhaps be met by the suggestion that fresh supplies of chlorophyll are continually being formed, but we have no knowledge yet at present of any such continual formation of chlorophyll; on the contrary, it is a well-established fact that when once the chlorophyll of a corpuscle is oxidised, it does not regain its green colour.

It might perhaps be possible to obtain some further knowledge on this subject by observing the effects produced in cells by the action of strong light falling upon them, in some cases, directly, in others, after having passed through a solution of chlorophyll which would be renewed from time to time if necessary. If it were found, that, in the latter case, the cells remained uninjured whereas in the former they soon died, some important evidence in favour of Prof. Pringsheim's views would be obtained. It might then be possible to extend these experiments and to bring about the formation of starch from carbonic acid and water in the cells of fungi, and even of animals, for Mr. Geddes' interesting observations on planarians show that animal as well as vegetable protoplasm is capable of effecting this synthesis.

SYDNEY H. VINES

THE CAMBRIDGE NATURAL SCIENCES TRIPOS

WOULD science suffer by the division of the second part of the tripos into a non-biological and a biological division which might be taken in successive weeks with separate examiners?

Let us make sure that in future geologists know well their chemistry and physics, and insist on all biologists knowing how to work their microscope well. Perhaps some geologists will shrink from a division of subjects ; and consider that every geologist should know palæontology well. But the study of fossil plants and animals is surely a part of systematic botany and zoology ; in fact, geology and palæontology would gain by being separated, so far as the one is physical, stratigraphical, petrological, and mineralogical, or the other truly biological. The knowledge of fossils as characterising a "formation" is not a biological subject ; a man may recognise fossils well enough for geological purposes who knows little of zoology properly so called. Biology suffers greatly from the want of palæontologists as distinct from physical geologists and petrologists. How many men are there who would agree that biology ("the study of things living or that have lived") is very difficult to separate from physical and non-biological subjects for examinational purposes? Let us acknowledge that it is more necessary that, at the commencement of his scientific career, a man should be known and recognised as a well-educated biologist than as a vegetable anatomist, or a palæontologist, or an embryologist. Every man seeking biological honours may find sufficiently little chemistry and physics in the first part of the natural sciences tripos not to daunt him, if he is capable of research. Surely it is better to secure a man's general physico-chemical knowledge if he is to be a geological surveyor of the first rank, and also train him in elementary biology, than to encourage too early specialisation.

My proposal is that in the second part of the natural sciences tripos four or more examiners should be specially chosen to set and approve the biological questions, and four or more, the physico-chemical and geological questions; that the latter should have a separate class-list and days of examination, with four written papers of three rows each, and a practical examination; and that the biological examination should have four papers and be in other respects similarly conducted, letting no special marks of distinction be given. Few first-rate candidates would desire to take both these examinations, and if they desire further distinction in particular subjects, original work in research or authorship, is surely the best test; and the University might subsequently give to competent men degrees in science which now it unfairly cannot give; the degree of Doctor of Science should be given to men qualified to be University Readers or Professors in Science.

Mr. Hillhouse, of Trinity, the Assistant Curator of the Cambridge Herbarium, and one of the editors of the *Cambridge Review*, in an article last week, admits that which many promoters of learning might think a sign of unrest and indecision, rather than of real growth, namely, that the regulations issued by the Board of Natural Sciences Studies must be very mutable, and continually need revision. As to the argument for human anatomy as such receiving a prominent place in a tripos, Mr. Hillhouse says it rests on the fallacy that men are likely to study a subject with more interest if it is made a subject of a tripos, than if it is included in the M.B. But, his experience is, the man who will not work for his M.B. will surely not work for his tripos; if anything, he will work better for M.B. than tripos.

The University of London, having for a long time required all candidates for the degree of B.Sc. to pass in elementary mathematics, physics, geology, palæontology, and the other biological sciences, as well as logic, has now reverted to the wiser plan of examining at its 1st B.Sc. in elementary mathematics, physics, inorganic chemistry, and elementary biology, and at the degree examination (for B.Sc.), giving the degree for passing in three out of nine divisions of sciences, so that a biological student may, if he chooses, enter for a very clearly-defined examination in botany, zoology, and physiology. The Cambridge man will then soon prefer the B.Sc. Lond., with the subsequent possibility of a doctorship in science, given for thorough attainment in the special subject of his life-study and teaching, unless biology receives fair play at Cambridge. Why is it that Martin, Hartog, Marshall, and Vines have taken their D.Sc. (Lond.), to mention biologists only? It is surely not that they are devoted to examinations, but that Cambridge was not yet able to give them the distinction in their chosen subjects which they were entitled to demand. Biology, worthy of the name, is still to a very considerable extent proscribed or suspected in Cambridge. In a future age how strange a survival of prejudice this will seem.

G. T. Bettany

THE PLANETS OF THE SEASON

Saturn

We recently called the attention of our astronomical readers to that noble planet, the captain of our celestial guard, those three that keep the mid-watch of the night in an imposing order that may not return for ages; at distances nearly equal, and in a line not widely deviating from a great circle of the sphere. Saturn, the next in position, may now be the subject of a cursory notice.

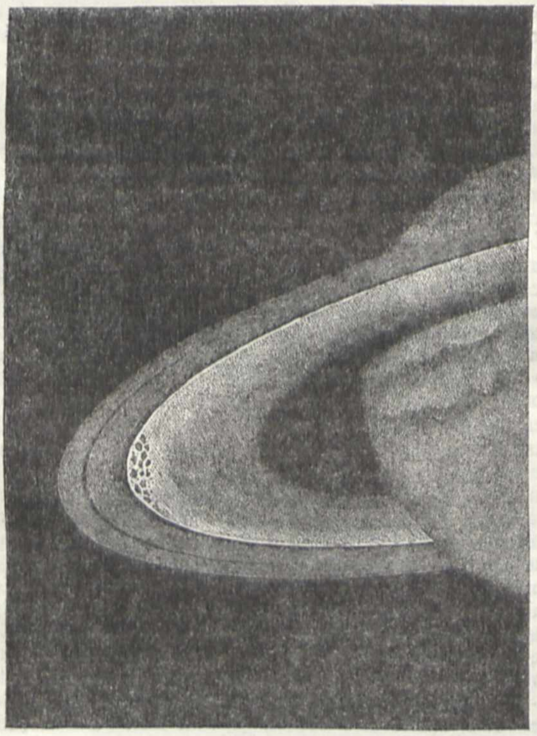
The aspect of this most interesting of the planets is at the present time singularly elegant and attractive. The relief, however, is delicate, and the details not conspicuous; but though the presentation may be less adapted for a close scrutiny than that of either the full opening or the evanescent phasis of the ring, its examination will not fail to reward the careful observer.

Schröter had a true insight into the pervading character of the universe when he described it as uniform in plan, with an endless variety in detail. Such is evidently the case with the planetary system. We find everywhere arrangements in part closely parallel or even identical with those most familiar to us, in part so rapidly divergent that the connecting analogies are strained, and thin away, as it were, till the bond of union can be traced no longer. Saturn is a complete instance of this. The dependence on the great central ruler, the spherical form, the polar flattening, the rotation on an inclined axis, the accompaniment of an atmosphere—all correspond with our own; while the differences, not only in magnitude, but in density and the force of gravity, are so great that we cannot even guess at the component materials. We endeavoured lately to point out how limited is our knowledge of Jupiter, though in various ways favourably circumstanced for observation; but on Saturn, with the exception of his change of seasons, we should find ourselves still greater strangers; and the terrestrial analogies that aided us so little there would here be of still less service. Every difficulty is magnified by the vast increase of distance and defalcation of light; we can only record what we see, and much of that is neither familiar nor intelligible.

It is easy, however, to perceive a strong general resemblance between these two great globes, not only in gigantic dimensions, want of density, and velocity of rotation, but in various atmospheric characteristics, such as parallelism of direction (sometimes, according to Herschel I., not quite equatorial on Saturn), contrasted colouring, and the occasional formation of bright and obscure patches. And yet in one main feature there is a very marked dissimilarity—the position of their axes. In this one point Saturn, after a decided interruption in the series, reverts to the type of the earth and Mars. And it is scarcely conceivable that the presence or absence of a change of seasons should not be strongly felt in its effects. One result, however, which might on a superficial view have been expected, is absent from Saturn. There is no luminous deposit around the poles, which, on the contrary, are often more dusky than the equatorial regions, and this alone would infer a different atmospheric constitution from our own, even if we left out of sight the consideration that such might well be expected when the subjacent materials are as light as cork, and the whole globe would float high out of water. But for this curious deviation from regular sequence—a kind of deviation so remarkable and so significant in the planetary system—we should have remarked as complete an analogy between Jupiter and Saturn as that which is believed to obtain between the Earth and Mars.

The changes, however, in the atmosphere of Saturn are not usually so conspicuous as those on Jupiter; nor is this to be wondered at, when we consider its inferior brilliancy at a distance measured by hundreds of millions of miles. The equatorial zone is usually represented as of prominent and unvaried brightness, and the dusky belts differ much in depth and arrangement at different times. Luminous and dark patches, though not common, are far from being unknown. The white equatorial spot, resolving itself ultimately into a streak, which was observed by Hall in 1876, though not, as has been asserted, an unprecedented, was a very remarkable instance of the former class, as one perceived by Herschel I., ninety-six years before, had been of the latter. This dusky spot was situated near the limb, where on Jupiter it would presumably have been invisible; yet much could not be inferred from this solitary observation, nor from that of Chacornac on the transit of the largest satellite, which showed a limb more luminous than the centre of the disk. Everything of this kind should be noted, but nothing pressed into the service of a foregone theory.

The flattening of the sphere at the equator, as well as the poles, announced by Herschel I. as the result of many observations in 1805, has never been very satisfactorily explained. It might have been discarded as an illusion resulting from the crossing of the outlines of the globe and rings, had it not been confirmed by repeated measurement at the time. It is considered to have been subsequently disproved by a repetition of that process in other hands; but it does not appear that the latter measures were taken at a time when the alleged deception existed. An experiment might be tried of placing at a distance from the eye (or better, the telescope, to insure perfectly similar conditions) a transparency copied from Herschel's figure, but with an elliptical, instead of "square-shouldered," outline; but even if, under any varied illumination, the deception should recur, his measures would still have to be accounted for, which do not seem to have been affected by any imperfection in his micrometer.



Part of Saturn's ring as observed by Trouvelot with the 26-inch Washington refractor.

But however this apparent anomaly may be disposed of, we are brought face to face, in the ring-system, with phenomena unexampled, as far as our sight can reach, though there may be thousands of them, and of still stranger things in the depths of infinity. The minor peculiarities of this complex arrangement are at present not readily traceable in so foreshortened a projection, and some of them would require instruments of great light and power; but the gauzy portion of the slowly-opening ring is already within the reach of moderate apertures. On many accounts these marvellous features deserve an increasing degree of scrutiny as the opportunities for it are becoming more and more favourable; and we may yet gain a further insight into their structure. Still we must not expect too much. Even should the bright rings be, according to the prevalent opinion, a closely-packed mass of satellites, we can hardly suppose it to be "resolvable" with any future increase of optical power. Theory, indeed, pronounces against a solid or even fluid composition; but the confident application of theory may possibly prove hazardous where materials wholly unknown may be dominated by polar forces of unexplored intensity. It may, indeed, be still an open question whether the aspect of the dusky ring, especially as projected across the ball, can be reconciled with the idea of a thin and scattered stream of satellites, an idea that perhaps would never have occurred to any actual observer, and that seems only a theoretical consequence of the supposed constitution of the other rings. Many questions, in fact, remain open, in this system of wonders; whether its general dimensions, or the proportions of its several parts, are unchangeable; whether minor divisions can always, or ever, be established; whether the gauze ring is distinctly separated from its neighbour; whether its colour is invariable; whether a similar material glazes over, so to speak, the great division of the two bright rings; whether any plausible explanation can ever be attempted of the extraordinary outlines of the shadow of the globe upon the outer ring, consistent with a thinness edgeways almost invisible. There may well be "more things" here "than are dreamt of in our philosophy." And in respect of the general idea of possible changes, it is but fair to bear in mind that our knowledge of this planet is confined to a relatively short period, as compared with his annual revolution. Only some seven Saturnian summers and as many winters have been exercising their influence on that peculiarly delicate and complicated system since the first employment of telescopic investigation—far less time since the commencement of minute scrutiny. And in addition to this the excentricity of the orbit is sufficient to vary the amount of solar radiation at different periods of his year, much more than is the case with our own globe.

It should not be forgotten, too, that the rotation of the ring has hitherto been deduced from theory alone, and ought, if possible, to be determined by observation; though where Herschel I. has failed, and Bond has not succeeded, there may not be a very bright prospect for subsequent observers.

The satellites are interesting in many respects; among others they afford a curious instance of the diversity of detail with unity of idea already alluded to. In our own case the attendant bears so large a proportion to its primary that Earth and Moon have been compared to a double planet. Next, in Mars, we find a ratio of the most opposite description. In Jupiter an intermediate proportion exists between the primary and secondaries, while the latter do not differ in magnitude very widely among themselves. In Saturn we have an extension and combination of the previous systems, not only in number but in character; extreme minuteness in several being found in juxtaposition with considerable bulk in one of the attendants. The striking irregularity of their sequence in point of magnitude is a fresh exemplification of the deviation from uniformity already referred to as so generally, and indeed almost universally, observable in the solar system. It may be noted among the retinue of Jupiter, where the largest is not the outermost of the satellites; but it is still more observable in the more complicated arrangement of the satellites of Saturn. The smallest in a general sense range nearest to the primary, yet the largest is not the most distant; and next in position to him comes the most minute of all. On the same principle it is highly unlikely that the regular progression 1, 2, 4, 8 should express the real number of the satellites attending respectively on the Earth, Mars, Jupiter, and Saturn. More, probably, own the control of the latter, and may be reserved as a triumph for Mr. Common's magnificent 37-inch mirror which the spirited possessor fully deserves.

The well-known fact that the difficulty in detecting objects of this nature diminishes as they become more familiar, is well exemplified in these minute points. Enceladus, once considered as suitable only for great apertures, has been several times seen by Franks with a 5-inch object-glass; my less acute vision with 9½ inches of a silvered mirror distinguished it in 1878, not readily, indeed, but quite certainly, in the absence of the primary from the field.

The variable light of the outermost, Japetus, in different parts of his orbit, has long been known, and might have been readily explained by a synchronism of rotation and revolution, but for superinduced irregularities similar to those of the satellites of Jupiter, and probably depending upon a similar cause. Schröter detected differences of brightness in some of the others, on opposite sides of the planet; but the subject deserves a fuller investigation.

T. W. WEBB

NOTES

WE record with deep regret the death of John Allan Broun, F.R.S., on Saturday last, at the age of sixty-two years. Mr. Broun was many years in India, as Director of the Observatory of the Maharajah of Travancore, and has been resident in London for the last six years. We hope next week to give details of Mr. Broun's life and the valuable services he has rendered to meteorology.

WE regret to learn that Prof. A. H. Sayce is compelled to spend the winter in Egypt on account of his health. We trust his sojourn on so congenial a soil will quite re-establish him.

A MARBLE medallion of Father Secchi has been placed in front of the Stilvio Observatory, 2,543 metres above the level of the sea. The observatory owes its establishment to him.

THE Swedish Academy of Sciences has appointed Dr. B. V. Wittrock, the celebrated algologist, to be keeper of the botanical department of the Swedish State Museum, in succession to Prof. N. J. Andersson, who has retired in consequence of the bad state of his health.

THE works for creating an astronomical observatory on the top of Etna were progressing favourably, but have been arrested for some months owing to the state of the weather. The central iron cupola and the telescope would have been placed this year if the operation had not been prevented by the large quantity of snow which fell prematurely on the mountain. This establishment is unrivalled for its position under an admirable sky, and will be placed on an immense natural platform situated at an altitude of 3,000 metres above the sea. The central crater has an elevation of 350 metres, and the observatory has been built at its very foot. An hotel is also being built, where twenty persons can find board during fine weather.

THE Municipal Council of Lyons, after a protracted discussion, has voted a credit for raising a statue to Ampère, who was, with Arago, the inventor of the electro-magnet. Ampère was a Catholic, and the son of a magistrate who had been beheaded at Lyons after the great revolution of 1793. The elder Ampère had written the charge against Challier the *Montagnard*, whose death caused the breaking out of civil war and the shedding of the blood which deluged Lyons during so many months.

THE death is announced of the eminent physicist, Friedrich von Ewald. He died at St. Petersburg on October 16 last, at the age of sixty-six years. He was for many years instructor to the Czarewitch.

FRIENDS and admirers of the late Herr Theodor Heuglin, the well-known African traveller, have erected a monument to his memory in the Prager Cemetery, at Stuttgart; it consists of a large erratic block from Upper Suabia, adorned with the medallion portrait of the deceased. Prof. Kopff, of Baden Baden, was the sculptor of the medallion. The monument was unveiled a few days ago.

THE death is announced of Mr. Serjeant Cox, on Monday, in his seventieth year. Mr. Cox was known as the author of several works in physiological psychology, written mainly from a spiritualistic point of view.

AT Hamburg, the resolution has been passed to erect a new Natural History Museum, for which the sum of 1,000,000 marks (50,000*l.*) will be expended. It appears that through the great marine trade of the city, its rich natural history collections are rapidly increasing year by year. Up to the present not one half of these collections could be properly exhibited to the public for want of space. All this will be changed when the new building is completed.

A CATALOGUE of scientific serials, from 1633 to 1876, has been recently prepared by Mr. Samuel H. Scudder, assistant-librarian at Harvard College Library, and under the auspices of that library, which has met the expense of publication, with the expectation that the demand for the volume will refund the outlay, and with the promise that, if so far remunerated, this shall be the beginning of a series of "works such as may be properly undertaken by a public library, and do not offer inducement for commercial speculation." The catalogue embraces the transactions and bulletins or proceedings of learned societies in the natural, physical, and mathematical sciences of all countries, as well as independent journals. It is the result of a large amount of painstaking labour and should prove an invaluable companion to those engaged in research, or otherwise interested in the progress of science.

FEW local natural history societies can show a better record of work done than the Torrey Botanical Club, the *Bulletin* of which is published monthly or bi-monthly. In addition to records of localities and descriptive articles of local and geographical interest, the pages of this publication not unfrequently contain contributions of sterling value on important points of morphology and physiology. Articles of this character in the numbers which have recently reached us are "Notes on the Relative Age and Dimensions of a Number of Different Trees," by N. L. Britton, and "A Few Notes on the Abnormal Absence of Colour in Plants," by A. Hollick.

IT is intended to erect a statue at Hanover in memory of the late eminent technologist, Karmarsch.

THE recent Hungarian earthquakes were coupled with phenomena of a most remarkable nature. The large island in the Danube near Old Moldowa was completely cleft in two by one of the shocks. From the chasm thus formed a gigantic column of water shot forth partly flooding the island. On October 18 the giant fountain suddenly ceased to flow, but numerous funnel-shaped craters had formed from which black sand and clay were ejected. Near Weisskirchen the old ruins of the Castle of Golubacz have fallen in completely, and in the vicinity several caves were rendered inaccessible. These caves were the breeding places of the dreaded Kolumbacs mosquitos, and if this insect is thus exterminated the earthquake may, with all the damage it did, have yet been of some use. Another smart shock was felt at Temesvar on Friday morning last. A violent earthquake is reported from Iceland. It occurred on September 24 last and is ascribed to volcanic eruptions in the Krisuvik mountains, a locality where eruptions have not been known within the memory of the present generation.

RUDOLF FALB has written from San Francisco to German friends to inform them that a monument in Bolivia much more ancient than the times of the Incas has given him a clue to the origin and development of speech and writing. He is apparently inclined to recur to the Semitic hypothesis.

AT the opening meeting, last week, of the Society of Arts the following prizes were awarded:—The Gold Medal, offered for the best means of saving life at sea, to Messrs. J. and A. W.

Birt, "for the collection of buoyant articles sent in by them;" the Society's Silver Medal, to Mr. Herbert Singer, for his "Essay on the Art of the Silversmith;" to Mr. F. Toplis and to Mr. Joseph Lucas, for their papers containing "Suggestions as to the best Means of dividing England and Wales into Districts for the Supply of Pure Water;" to Mr. Alfred Haviland, M.R.C.S., for his paper on "The Distribution of Disease popularly considered;" to Mr. John Hollway, for his paper on "A New Application of a Process of Rapid Oxidation, by which Sulphides are utilised as Fuel;" to Mr. Conrad W. Cooke, for his paper on "Edison's Loud-Speaking Telephone;" to Mr. Thomas Wardle, for his paper on "The Wild Silks of India, principally Tusser;" to Dr. William Wallace, F.R.S.E., for his paper on "Gas Illumination."

THE second part of vol. xxiv. of the "Mémoires de la Soc. de Physique et l'Histoire Naturelle de la Genève" has just appeared. It contains:—Report of the President to December 31, 1878, by Prof. E. Wartmann; Researches on the Fecundation and the Commencement of Henogeny among Various Animals, by M. Hermann Fol; On the Genus Hemimerus, Wolk., apparently furnishing a new order in the class of Hexapods, by M. H. de Saussure; Description of a New Species of Trygonid belonging to the genus Pteroplatea, by M. Godefroi Lunel; Comparative Anatomy of the Leaves in some families of Dicotyledons, by M. Casimir de Candolle.

IN reference to an article in the *Globe* on Sapphires in Siam, Mr. Bryce-Weight writes to that paper that through one of the Siamese princes in England he has learned that there are several sapphire mines in Siam, on the sea coast, with thousands of people at work, valuable gems having been found and sold at a good profit.

IN the beginning of October there was discovered, at about a kilometre from Guisseny, under a mass of rocks, a cavern fifteen metres long by four broad. This cave has two openings, one towards and about four metres above the sea, the other towards the land. The cavern was found throughout its length covered with a bed of ashes and charcoal about two centimetres thick. Underneath this was found a sort of dry stone masonry, then human bones, remains of cinerary urns, evidently of "Celtic" origin, and a considerable quantity of bones of mammals. Among the latter are some which do not appear to belong to contemporary fauna. Finally, a stone hammer and a sharp, polished axe of porphyry appear to show that this cavern is a sepulchral grotto of prehistoric times.

A SECOND enlarged edition is announced by Mayer, of Cologne and Leipzig, of Sonnenschmidt's "Kosmologie," the history and development of the universe on the basis of the most recent scientific researches.

THE *Journal of Applied Science* draws attention to the substitution of paper for wood in Germany in the manufacture of lead-pencils. It is steeped in an adhesive liquid and rolled round the core of lead to the required thickness. After drying, it is coloured to resemble an ordinary cedar pencil. The pencils sell in London to retailers at about 3*s*. a gross.

AT the first meeting of the Statistical Society, on the 18th inst., the President, Mr. Brassey, presented the Howard Medal and 20*l*. to Miss Beatrice A. Jourdan, as the writer of the best essay "On the Improvements that have taken place in the Education of Children and Young Persons during the Eighteenth and Nineteenth Centuries." The President announced as the subject of the essay of next year, "The Oriental Plague, in its Social, Economical, Political, and International Relations."

THE long pending telephone litigation in the United States has at last been settled by a compromise which leaves Prof. Bell master of the field. The National Bell Telephone Company have bought up the conflicting rights, and acquired all the telephonic inventions of Elisha Gray, of Mr. Edison, and of Mr. G. M. Phelps. The Western Union Telegraph Company, however, is to be licensed to convey telephonic messages, while the right to establish telephone exchange systems is to remain exclusively with the Bell Company. The shares of the National Bell Telephone Company are now quoted at 700 per cent.

THE distribution of the correct time by electricity, as inaugurated by Leverrier, is now organised at Paris, on an immense scale, by the Municipal Council. A length of 15,000 metres of tubes is placed alongside the Boulevards and the principal streets, where a large number of dials will mark the time during day and night. Private clocks will be kept to time on payment of a small fee.

A COMPETITIVE experiment took place on September 19 in the green-room of the Grand Opera of Paris, on the respective illuminating power of Jablochkoff candles and Werdermann lights. The Werdermann light was found most steady, and the Jablochkoff most powerful. The experiments will be continued next week before the public, and a final resolution will be taken afterwards. The President of the Republic and the Minister of Fine Arts are represented.

ON November 11 the stream of falling stars was observed, at nine o'clock, at Chatelherault, when the sky was exceptionally clear.

A COURSE of six evening lectures on Photography will be given at the Sorbonne every Thursday evening by M. Davanne, President of the Photographic Society of Paris, with experiments. These lectures are organised by the Scientific Association of France, presided over by M. Milne Edwards. The ordinary evening lectures will begin only in January.

THE second French Atlantic cable has been successfully laid down from Brest to the American shores, through the Scilly Islands and Newfoundland. Congratulatory messages have been exchanged between the Presidents of both Republics.

PHOTOGRAPHERS, professional and amateur, will, we believe, derive much assistance from the "Photographic Printer's Assistant," by Mr. W. Heighway, just published by Richardson and Best. The directions given are such as have been found successful in actual practice.

M. CHARCOT, the chief physician of Salpetrière, opened, three years ago, a course of lectures on nervous affections, annexed to his clinic. The number of persons asking for admission has been so considerable that the administration of Public Assistance has built an amphitheatre with 500 seats in the hospital. The lectures, which are delivered every Sunday, were begun on November 16, before a full house. The amphitheatre was fitted up with an Alliance Magneto-electric machine, worked by the steam-engine of the washing-house. In each lecture a number of patients are introduced on the platform illustrating the theories of the lecturer, and many photographs are projected on the screen by electricity. In the lecture of November 23 the lecturer projected two engravings reproduced from Montgeron, an author of the beginning of the eighteenth century, who advocated the genuineness of miracles executed on the grave-stone of Diacre Paris. One of these represented a young lady who had been declared by the doctors of the age to be incurable of club-foot, and the other engraving the same person after having been cured in a trance. These two figures were engraved and published by Montgeron as exhibiting a case of supernatural agency. M. Charcot proved they were analogous to several of the cases which had been presented to his audience and could be cured by the same process.

DR. RICHARDSON asks us to say that in his article on Fleuss's New System of Diving in last number, p. 63, col. 2, 25th line from bottom, "fully seven minutes" should be "forty-seven minutes."

THE additions to the Zoological Society's Gardens during the past week include a Yellow Baboon (*Cynocephalus babouin*) from West Africa, presented by Mr. Cecil B. Hankey; a Collared Peccary (*Dicotyles tajaçu*) from South America, two Domestic Sheep (*Ovis aries*), presented by Mr. H. Sandbach; a Little Grebe (*Podiceps minor*), British, presented by Mr. A. F. Buxton; a South American Rat Snake (*Spilotes variabilis*) from South America, presented by Mr. Thomas Harrod; two Geoffroy's Cats (*Felis geoffroii*) from Paraguay, two Barbary Falcons (*Falco barbarus*) from North Africa, a Red-throated Diver (*Colymbus septentrionalis*), British; a Common Curlew (*Numenius arquata*), European, deposited; two Common Tiskins (*Chrysomitris spinus*), a Reed Bunting (*Emberiza schœnichus*), a Pied Wagtail (*Motacilla yarrelli*), British, purchased; a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi*), two Smooth Snakes (*Coronella lævis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE "URANOMETRIA ARGENTINA."—The publication of this great and meritorious work is just announced, though, so far as we know, the complete volume has not yet reached Europe. The system of observations upon which it is based was designed and commenced by Dr. B. A. Gould, the distinguished director of the Argentine Observatory, immediately after his arrival at Cordoba in September, 1870, on accepting the superintendence of the new establishment, and while awaiting the completion of the observatory buildings and the arrival of telescopes which had been ordered in Europe, but delayed by the outbreak of the Franco-German war, and the work upon it has been continued with more or less attention to the present year. It was intended to represent in a series of charts and accompanying catalogue the sky from the south pole as far as 10° north of the equator, as it appears to the naked eye, showing all stars down to a round magnitude fixed at 7·0, with their characteristics of duplicity, variability, and colour, and the milky-way in all its ramifications and gradations of brightness. The actual observations were assigned to the four assistants, Messrs. Rock, Davis, Hathaway, and Thome, who had proceeded to Cordoba from the United States, the first three returning home at the expiration of three years, when the Uranometry was already finished as to its general details. Mr. Thome subsequently reviewed the entire work twice, and with the result that Dr. Gould considers it improbable that any star so bright as 7·0, on a scale which it has been desired to extend accurately from Argelander's, will have escaped insertion, while notwithstanding the great degree of nicety implied, he thinks the magnitudes are essentially correct to the nearest tenth. During the first two years the work was continued on all cloudless nights, both summer and winter, at an average of six hours' work each night. The total number of stars of which the magnitudes have been assigned is 10,649, and the total estimates of magnitudes 44,510, or more than four for each star.

With the view to having a uniform basis for estimates of magnitude throughout the whole heavens, Argelander's magnitudes for a region lying from 5° to 15° north of the equator, having the same meridian altitude at Bonn and Cordoba, were collected by classes, and "the stars of each class then assorted and shaded into the adjoining ones until a scale of tenths was formed." . . . "The scale as finally adopted resulted from the accordant estimates of all four assistants for each tenth up to 7·0." A "Type-belt Catalogue" of 722 stars was formed in this way, intended, as we have intimated, to serve as a standard for all future determinations of magnitude, in whatever part of the heavens. All the stars occurring in the "Uranometria" have been observed for accurate position at least four times with the meridian circle, and a general catalogue will appear in due course.

The charts are thirteen in number, and an index-chart is added showing at once the whole extent of the Uranometry. The printing was effected by the photolithographic process, as the most accurate and least expensive. Photographic negatives of the manuscript charts were taken, thus permitting their exact transfer to the stones. The chief trouble experienced in the printing was to give the star-dots the proper blackness, and yet to keep the milky-way within reasonable shade.

In a special chapter, Dr. Gould collects all variable and suspected variable stars, with particulars, thus providing interesting work for those amateurs who can command the southern heavens, and work from which much may be learned.

From a discussion of the general distribution of the stars throughout the sky, Dr. Gould is led to conclude that "there is in the sky a girdle of bright stars, the medial line of which differs but little from a circle inclined to the Galactic circle by a little less than 20°. The grouping of the fixed stars brighter than 4·1 is more symmetric relatively to that medial line than to the Galactic circle, and the abundance of bright stars in any region of the sky is greater as its distance therefrom is less. The known tendency to aggregation of faint stars towards the milky-way is according to a ratio which increases rapidly as their magnitudes decrease, and the law of which is such that the corresponding aggregation would be scarcely, if at all, perceptible for the bright stars." These facts, Dr. Gould continues, indicate the existence of a small cluster, within which our own system is excentrically situated, but which is itself not far removed from the mean plane of the Galaxy; this cluster he considers to be of a flattened shape, somewhat bifid, and consisting of rather more than 400 stars, of an average magnitude of 3·6 or 3·7, but comprising stars from the first to the seventh.

We have abridged these particulars from an interesting article on the "Uranometria Argentina," in the Buenos Ayres *Standard*.

It is impossible to avoid expressing admiration for the scientific spirit and enlightenment of the Government of the Argentine Republic in providing means for the execution of this important work, the first astronomical contribution from their National Observatory, but, we believe, to be followed by others, for which materials are completing, and which, it cannot be doubted, under the superintendence of Dr. Gould, will collectively secure for the Observatory of Cordoba a high position in the history of astronomical establishments, and, in connection with other enterprises of which we hear from time to time, for the comparatively small nation by which it is supported, the respect and good wishes of the scientific world.

THE "LICK OBSERVATORY," CALIFORNIA.—From San Francisco we receive details of recent progress towards carrying out the intentions of the will of the late James Lick, who died October 1, 1877, bequeathing the sum of 700,000 dollars to trustees for the purpose of purchasing land and erecting upon it "a powerful telescope, superior to and more powerful than any telescope ever yet made," with an observatory and other appurtenances, to be conveyed eventually to "the Regents of the University of California." The first site considered was at Lake Tahoe, but it was soon rejected; Mount St. Helena, at the intersection of Napa, Sanoma, and Lake counties, was then visited; it is upwards of 4,300 feet high, and was known to have atmospherical conditions favourable for astronomical purposes. Mr. Lick spent one night upon its summit. Among other points visited was Mount Hamilton, the elevation of which is still greater, and Mr. Lick finding that its advantages, so far as known, were equal to those of the former mountain, finally determined upon Mount Hamilton as the site of his proposed observatory; it is something less than fourteen miles east by south, from San José in Santa Clara county. A road to the summit twenty miles long was commenced in 1875, and finished in December, 1876, at the expense of Mr. Lick, and surroundings to the extent of more than 1,500 acres were secured to form the observatory property. The site was thus, contrary to what has been generally stated, decided upon before Mr. Lick's decease, and Prof. Newcomb had been asked to test the capabilities of the station, to obtain a guide as to the size and character of the instrument or instruments to be provided; Prof. Newcomb was too much engaged upon his official duties to undertake this work in 1877, and recommended application to be made to Mr. S. W. Burnham, of Chicago, who arranged last April to visit Mount Hamilton, with his own 6-inch Alvan Clark refractor; he arrived in the middle of August, and after spending thirty-two nights upon the mountain, up to September 27, all of which except five were extremely favourable, he appears to have agreed in opinion with Prof. Newcomb, who was able to visit Mount Hamilton early in October, that it is "the finest observing location in the United States." With regard to the size of the great telescope to be mounted there, much will probably depend upon the success attending the construction of the 30-inch refractor, which Alvan Clark and Sons have engaged to furnish for the Imperial Observatory at Pulkowa, but the trustees purpose to secure a 12-inch to be used in the observation of the next transit of Venus, and to remain one of the permanent fixtures of the Observatory.

San José is in about 121° 50′ west of Greenwich, and 37° 16′ N. Of Mount Hamilton it is stated that, "although practically out of the coast range fog-belt, an occasional gale blows the mist across the Santa Clara Valley from two points—Monterey Bay and the Sand-hill Gap just south of the city. On extraordinary occasions this fog reaches the crest of Mount Hamilton, but ordinarily the sky is cloudless all summer." The trustees have their work well in hand, though there remains much to be done before the whole design of the munificent founder of the observatory can be realised. It is intended that a meridian-circle, an instrument necessarily requiring considerable time in its construction, and other accessories, shall be provided in addition to the great telescope and the smaller equatorial. If we are not mistaken, Mr. Burnham has added a number of new double-stars to our lists, from his tentative work with the 6-inch refractor on Mount Hamilton.

GEOGRAPHICAL NOTES

A RUSSIAN journal announces the early departure of a scientific expedition, under the direction of Lieut. Onatsevitch, to make hydrographic investigations in the Sea of Japan and the Sea of Okkotsk. One of M. Onatsevitch's assistants, Ensign Heller, has already gone to Vladivostock in the cruiser *Asie*, taking with him numerous instruments with which the hydrographic department has equipped the expedition. M. Lanevsky Volk and four other naval officers will accompany M. Onatsevitch by way of Siberia. The object of this expedition is to fill lacunæ in the works of Babkine, Bolchew, Staritsky, Yelagnine, and others. It will have to explore, especially from the hydrographic point of view, the mouths of rivers which fall into the Sea of Japan, from the southern frontier of Russia to the Bay of Castries. It will make geodetic observations in the southwest part of Peter the Great Bay and at the mouth of the Amour. Lastly, it will study the water-courses, and the east and south parts of the Isle of Sakhaline, the district of La Perouse, &c.

AT the meeting of the Geographical Society on Monday evening the secretary read a paper by Capt. A. H. Markham on the Arctic campaign of 1879 in the Barents Sea. The title of the paper, however, is somewhat of a misnomer, as the narrative was chiefly confined to the proceedings of the *Isbjörn*, to which we have already referred. Some few details were also furnished as to the trip of the second Dutch expedition in the *Willem Barents*. Among the various matters of interest dealt with, perhaps one of the most interesting was the description of a large glacier on one part of the coast of Novaya Zemlya. This glacier Capt. Markham ascended, and walked along it for some two or three miles into the interior; he found numerous fissures in it, at the bottom of which ran rivulets, and some of which were so deep and wide that they could not be crossed except by making a long *détour*. During the trip a considerable amount of information was gained in regard to the movements of the ice in the Barents Sea, and the best season for future attempts at exploration, especially in the direction of Franz Joseph Land; it was made quite clear, however, that a larger vessel and the aid of steam are absolutely necessary to secure really useful results.

WITH reference to the discovery of the sources of the Niger, it is stated that MM. Zweifel and Moustier traversed the Hokko and Limbah countries, which, covered with forests on Winwood Reade's visit ten years ago, was now found very little wooded, the demand for the oily almonds of the palm tree having induced the natives to plant oil palms in the place of forests. A Koranks mission told the explorers that the Niger passed between Mount Lomat and another mountain, and that its three sources, the junction of which formed a small lake, were two days' march from the latter. After many dangers and privations, the travellers found the main source near the village of Koulaks, on the frontier of Koranks, Kissi, and Kono, its native name being the Tembi. The travellers could not enter the Sangara country on the right bank of the river; but they are confident that the Tembi is the longest of the three streams mentioned by the Koranks, and consequently the origin of the Joliba or Upper Niger.

M. DE LESSEPS is to leave in a few days for Central America, in order to survey the concession granted by the Columbian Government for a sum of 750,000 francs, which was paid a few months since. The surveying within a certain time is an obligation which, not being complied with, would render the concession void. The promoter of the new canal took leave of the Geographical Society of Paris on November 21.

THE Freie Deutsche Hochstift at Frankfurt has received further news from Dr. Gerhard Rohlfs and his travelling companion Dr. Stecker, according to which the two travellers were already on a steamer sailing for Malta. Herr Rohlfs is said to be so exhausted that he intends to abstain from any further African exploring expeditions. Amongst the objects which the travellers were robbed of are all their diaries, notes, and scientific instruments, besides the rich collection of presents sent by the Emperor of Germany to the Sultan of Wadai.

NO. 10 of Band xxii. of the *Mittheilungen* of the Vienna Geographical Society, contains papers on the Ethnological Conditions of South Russia at their chief epochs, from the earliest times to the first appearance of the Sclavs, by Dr. Jar. Vlach; the Mississippi and its Basin, by Dr. Hesse-Wartegg; the district of Shushu, in Transcaucasia, by Carla Serena. Among the notes is a valuable statistical and geographical account of the Vilayet of Trebizond, from an Austrian Consular Report. As a supplement to the *Mittheilungen* is announced a *Zeitschrift für wissenschaftliche Geographie*, edited by Julius Iwan Kettler, assisted by a staff of eminent German geographers. This journal will embrace all departments of mathematical, physical, commercial, ethnological, descriptive, and historical geography; and promises to prove one of the most valuable geographical journals published. It will be issued every two months.

CAPT. HOWGATE has published a neat little volume on the cruise of the *Florence* in the preliminary Arctic Expedition of 1877-8. He gives many interesting notes made during the wintering in Cumberland Gulf, both of the country and people. The scientific results have been published separately, and these we shall notice in detail.

THE *Cape Argus* announces the starting in October of an African Expedition from the Cape, under, and at the expense of, two young Englishmen, Messrs. Beaver and Bagot. They have only two bullock waggons and a few blacks, but their ambitious programme is to make a "General and Astronomical" survey of the whole region between the Zambesi and the Albert and Victoria Nyanzas. This region is ignorantly described in the *Argus* as being almost totally unexplored. The two light-hearted young Englishmen allow themselves four years to accomplish their gigantic undertaking. We shall watch their progress with curiosity. They are stated to have had an interview with the Geographical Society before leaving; the officials of the Society, we believe, are not able to recall the incident.

IN a letter to M. Sibiriakoff, Prof. Nordenskjöld expresses his intention of undertaking another voyage to the northern coast of Asia as soon as circumstances permit. "After my return," he says, "I think of spending a year on preparing an account of the voyage of the *Vega*, and it is my desire then to continue the exploration of the Icy Ocean along the coast of Siberia, making the River Lena the point of departure, and the New Siberian Isles the basis of operations. For the object I have proposed to myself—namely, the rendering of the northern part of Asia completely accessible to commercial shipping—the prosecution of these researches is of paramount importance."

A TELEGRAM to the *Moscow News*, dated Katt Koorgan, November 14, gives the latest intelligence received from the Russian scientific expedition appointed to explore the Oxus or Amu Darya, and report on the best route for a great Central Asian railway. On October 19 the members met the Khan of Khiva, who said he would give orders in due time for the demolition of the dams at Bant and Shamurat. The eldest men among the Yomouds and Tschenderen pledged themselves to procure labourers for the purpose of cleaning out the bed of the Usboi between Sary Kamysch and the Caspian Sea.

THE death is announced of the Dutch lieutenant, Koolemans Beynen, who accompanied Sir Allen Young in his two *Pandora* voyages, and last year was second in command of the Dutch

Arctic expedition in the *Willem Barents*. He edited for the Hakluyt Society an account of the three voyages of William Barents. A daily contemporary confounded Lieut. Beynen with the well-known Arctic explorer, Lieut. Payer, who, we are glad to say, is alive and as well as ever.

RECENT advices from Japan state that the port of Gensan in Corea has been opened to Japanese traders. The Japanese, however, appear to have been more anxious to obtain the opening of Nikawa, a more important place, and about nineteen miles from the capital, Hányang (Seoul). The Coreans refused to concede this point, probably on account of a sacred character attaching to the road which separates the two.

BIOLOGICAL NOTES

OOSPORES OF "VOLVOX MINOR."—Dr. Kirchner, in the recent part of Cohn's "Beiträge zur Biologie der Pflanzen," describes the germination of the oospores, and in this supplements the important contribution made by Cohn himself to our knowledge of this interesting plant in the first volume of the same work. The first appearance of germination was in February. The contents of the oospores during a rapid swelling out of the endospore, made their appearance through the ruptured exospore, and soon presented a sphere-shaped body, which then divided into two portions, these being perpendicular to one another. The newly-formed cells so separate from one another that they hang together by their ends. These ends form the one pole of the later-to-be-developed ball-like colony; the other pole is afterwards closed in, when the maximum of the cells is attained. Each oospore thus gives rise through cell division, followed by the characteristic cell displacement, to a new volvox colony. The fact of *V. minor* being diœcious was given as a character to distinguish it from *V. globator*, but this, according to the author, does not hold true; both colonies seem to pass through a purely female stage and afterwards through a male stage, each colony being bi-sexual.

CEDAR OF LEBANON IN CYPRUS.—Sir Samuel Baker, in his late residence in this island, has been fortunate in bringing to light the existence of this tree, or a variety of it, according to Sir J. D. Hooker. It seems the monks of Trooditissa Monastery assured the former that the "chittim-wood" of Scripture, a kind of pine, grew in the mountains near Krysokus. Trusty messengers having been despatched in search thereof, they brought back specimens of a cedar, with dense foliage and a superior quality of wood. Sir J. Hooker, to whom the specimens were forwarded, after a careful examination, finds that this tree differs from the true cedar of Lebanon in having shorter leaves and smaller female cones, with other slight differentiations. He names it, therefore, *Cedrus libani*, var. *brevifolia*, a short botanical account of which, along with Sir Samuel's letter, he laid before the Linnean Society at their last meeting. In his letter Sir S. Baker further hints that a variety of cypress some thirty feet high and seven feet girth, with a cedar-coloured wood, and powerfully aromatic scent of sandal-wood, in his opinion, is the celebrated "chittim-wood." He asks: "Why should Solomon have sent for cedar, which is so common in Asia Minor?" Another hard-wooded cypress, of twenty feet high, yields an intensely hard wood resembling *Lignum vitæ*.

NEW GENUS OF MYRIAPOD.—In the October number of the *American Naturalist* Mr. J. A. Ryder describes and figures a new genus allied to the little myriapod described some years since by Sir John Lubbock as Pauropus. This new American form is found in moist situations under sticks and decaying vegetable matter. It is called *Eurypauropus spinosus*, receiving its generic name in reference to its great relative width. The body is composed of six segments, possibly of seven. The head is partly free, the surface of the head and other segments is covered with small tubercles or spines. Two pairs of legs are attached to each of the second, third, fourth, and fifth segments, which, with a single pair on the first segment, makes nine pair in all. The legs are completely concealed in life by the lateral expansions of the body segments. The oral region seems to be very similar to that in Pauropus. There is no evidence of tracheal openings. Eyes seem to be absent. The antennæ are five-jointed, inserted close together at the front of the head, and are branched. The outer branch bears two of the many-jointed filaments, between the bases of which arises a pedicel surmounted by an ovoid semi-transparent body with linear sepal-like processes clasping it much as in *Pauropus pedunculatus*. The length is one-twentieth of an inch, and the habitat Fairmount Park, Eastern Penna.

ZOSTERA MARINA.—A. Engler, in a recent number of the *Botanische Zeitung* (October 10), has published some interesting observations on the fertilisation and growth of the sea grass growing at Kiel. He pronounces Hofmeister's observations on the fertilisation of Zostera as incorrect, but corroborates those of Clavaud (published in the *Botanische Zeitung* for August). At first it is true that the thread-like stigma lies on the neighbouring anther lobes, mostly those of two different anthers; next the style elevates itself, and so the stigma comes out of the narrow slit in the sheath, and receives the pollen given out by some of the older spadices. After fertilisation, the thread-like stigmas disappear, and at the same moment will be found clusters of as yet unopened anthers around the stigmaless gynœcia, these now having fertilised ovules. This was probably the stage observed by Hofmeister when he described the fertilisation as taking place inside the unopened inflorescence. Certainly the anther-lobes are not at this stage always emptied of their contents, and certainly when this emptying takes place the gynœcia are often beyond the power of being fertilised. The conditions of the buds in Zostera also specially engaged Engler's attention, because the sympodial bud system appeared similar to that in many of Araceæ. The main shoot which roots in the mud develops out of the angle of the nodal scale like lower leaves, which, however, soon die off, sterile buds, and then after the formation of four to six internodes in the ground, grows upwards, now developing leaves often a metre long, but never in the same year is the inflorescence observed. The sterile sprouts are found to the right and to the left of the main shoot; the upper internodes of this latter elongate and erect themselves, but now in the angles of the lower leaves are only fertile buds developed, which lie alternately right and left of the main axis. The first fertile bud is generally quite free, and carries three to four club-shaped bodies sympodially arranged as described by Eichler. The following fertile buds grow for a great while along with the main axis, the axis of growth thus presenting a flattened cone-shaped form with two furrows superimposed on a cylindrical axis. As to the inflorescence, Engler suggests that it is not impossible, but that the Gynœcia and Andrœcia may each represent separate flowers so arranged that male and female flowers of the simplest type should stand opposite to one another. This, though opposed to the views of Ascherson and Eichler, seems to have some support from the fact that in the case of Spathicarpa ("Flora Brasiliensis," pl. 51), one of the Araceæ, this position of the male and female flowers occurs; only in this case, there can be no doubt of the fact, as there seems of necessity to be in Zostera, for the Andrœcia and Gynœcia are in Spathicarpa formed of several sexual leaves.

THE ONTOGENY AND PHYLOGENY OF THE CTENOPHORA.—Prof. Haeckel, in a recent number of *Cosmos* (vol. iii. Part 5, August, 1879), describes a new form which he calls *Ctenaria ctenophora*, as a connecting-link between the Ctenophora and the Medusæ. This species is figured, but fuller details are promised in the author's "System of the Medusæ," which, illustrated with forty plates, is nearly ready for publication. The new form is placed as a craspedote in the order of the Anthomedusæ, and in the family of the Cladonemidæ. Accompanying a brief description, there is an interesting paragraph on the "Ontogeny and Phylogeny of the Ctenophores." It would seem highly probable that the Ctenophores are descended from the Cladonemidæ, and that their still earlier ancestors were Hydrozoa allied to Tubularia. Among the newer adaptations, by means of which the Medusæ form of the younger Ctenophore originated, the most important is undoubtedly the change in the method of locomotion. The Medusæ swim in a spasmodic manner by irregularly contracting their umbrellæ, and then driving the water out of the cavity. The easy gliding, swimming movement of the Ctenophoræ is brought about by the vibrations of the little oar-blades which cross over the surface of the eight radial ciliated combs. While this newer form of motion took the place of the former, a number of other changes were immediately brought about according to the laws regulating the correlation of organs. The more important morphological relations were nevertheless, through the conservative power of inheritance, preserved. This interesting form possesses the eight ad-radial thread-cell channels as in Ectopleura, the trichter as in Eleutheria, the oral formation as in Cytæis, the canal-formation as in Cladonema, and the tentacles and tentacular pockets as in Gemmaria; transitory between two classes, it furnishes a new convincing proof of the verity of the doctrines of development.

Arsenic in Animals.—Prof. Ludwig has recently (*Wiener Akad. Anz.*) inquired into the distribution of arsenic in the animal organism after ingestion of arsenious acid. The objects he examined were the organs of suicides who had poisoned themselves with arsenic, and of dogs which were poisoned, some acutely, some chronically, with arsenic. In all experiments it was found that the arsenic accumulated most in the liver, and that in acute poisoning the kidneys also contained abundant arsenic, whereas in the bones and in the brain there was little of the poison. In case of chronic poisoning with arsenic, where death did not ensue, the poison was found to remain (after ingestion was stopped) longest in the liver, being much sooner excreted from the other organs. The results of this investigation are in direct opposition to those obtained by Scolosuboff, who always found most arsenic in the brain.

Dioptrics of the Eye.—In the investigation of the dioptric properties of the crystalline lens of the eye, physiologists have hitherto accepted an index of refraction of the lens determined for only one condition of accommodation. It seemed desirable to Herr Matthiessen to attain greater accuracy by ascertaining the dioptric properties of the lens in different states of accommodation, the structure of the lens as now known being fully considered. The subject is discussed at length by him in *Pflüger's Archiv* (xix. p. 480). In tabular form he presents a comparison of the positions of the dioptric cardinal points for the human eye and for the eyes of several lower animals, corresponding to different states of accommodation, infinite distance 160 mm. and 100 mm. A comprehensive list of works on the dioptrics of the lens and the eye generally is added to Herr Matthiessen's paper.

EXPERIMENTAL DETERMINATION OF THE VELOCITY OF LIGHT[1]

LET S, Fig 1, be a slit through which light passes, falling on R, a mirror free to rotate about an axis at right angles to the plane of the paper; L, a lens of great focal length, upon which the light falls, which is reflected from R. Let M be a plane mirror, whose surface is perpendicular to the line R M, passing through the centres of R, L, and M, respectively. If L be so placed that an image of S is formed on the surface of M, then, this image acting as the object, its image will be formed at S, and will coincide point for point with S.

If, now, R be turned about the axis, so long as the light falls on the lens, an image of the slit will still be formed on the surface of the mirror, though on a different part, and as long as the returning light falls on the lens, an image of this image will be formed at S, notwithstanding the change of position of the first image at M. This result, namely, the production of a stationary image of an image in motion, is absolutely necessary in this method of experiment. It was first accomplished by Foucault, and in a manner differing apparently but little from the foregoing.

In this case, L, Fig. 2, served simply to form the image of S, at M; and M, the returning mirror, was spherical, the centre coinciding with the axis of R. The lens, L, was placed as near as possible to R. The light forming the return image lasts, in this case, while the first image is sweeping over the face of the mirror, M. Hence the greater the distance, R M, the larger must be the mirror, in order that the same quantity of light may be preserved, and its dimensions would soon become inordinate. The difficulty was partly met by Foucault, by using five concave reflectors instead of one; but even then the greatest distance he found it practicable to use was only twenty meters.

Returning to Fig. 1, suppose that R is in the principal focus of the lens, L; then if the plane mirror, M, have the same diameter as the lens, the first or moving image will remain upon M as long as the axis of the pencil of light remains on the lens, and *this will be the case no matter what the distance may be.*

When the rotation of the mirror, R, becomes sufficiently rapid, then the flashes of light which produce the second or stationary image become blended, so that the image appears to be continuous. But now it no longer coincides with the slit, but is deflected in the direction of the rotation, and through twice the angular distance described by the mirror, during the time required for light to travel twice the distance between the mirrors. The displacement is measured by its arc, or, rather, by its tangent. To make this as large as possible, the distance between the mirrors, the radius, or distance from the revolving mirror to the slit, and the speed of rotation should be made as great as possible.

The second condition conflicts with the first, for the "radius" is the difference between the distances of principal focus and the conjugate focus for the distant mirror. The greater the "distance," therefore, the smaller will be the "radius." There

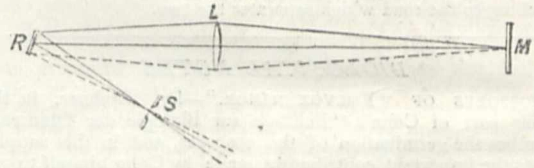


Fig. 1.

are two ways of solving the difficulty: first, by using a lens of great focal length, and, secondly, by placing the revolving mirror within the principal focus of the lens. Both means were employed. The focal length of the lens was 150 feet, and the mirror was placed about fifteen feet within the principal focus. A limit is soon reached, however, for the quantity of light received diminishes very rapidly as the revolving mirror approaches the lens.

The chief objection urged in reference to the experiments made by Foucault is that the deflection was too small to be measured with the required degree of accuracy. This de-

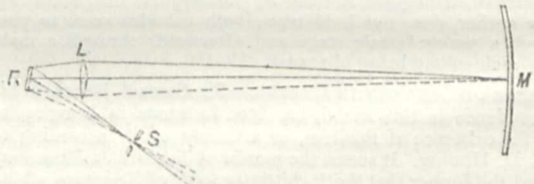


Fig. 2.

flection was but a fraction of a millimeter, and when it is added that the image is always more or less indistinct on account of atmospheric disturbances, as well as imperfections of lenses and mirrors, it may well be questioned whether the results could be relied upon within less than one per cent.

In the following experiments the distance between the mirrors was nearly 2,000 feet. The radius was about thirty feet, and the speed of the mirror was about 256 revolutions per second. The deflection exceeded 133 millimetres, being about 200 times that obtained by Foucault. If it were necessary it could be

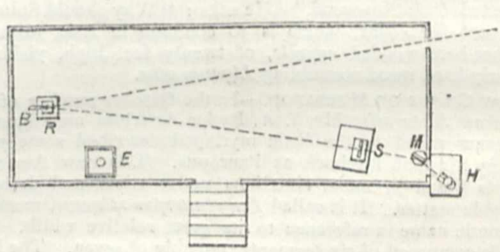


Fig. 3.

still further increased. This deflection was measured within three or four hundredths of a millimeter in each observation; and it is safe to say that the result, so far as it is affected by this measurement, is correct to within one ten-thousandth part.

The site selected for the experiments was a clear, almost level stretch along the north sea-wall of the Naval Academy. A frame building was erected at the western end of the line, a plan of which is represented in Fig. 3.

The building was forty-five feet long and fourteen feet wide, and raised so that the line of light was about eleven feet above

[1] By Albert A. Michelson, Master, U.S. Navy Read before the American Association.

the ground. A heliostat at H reflected the sun's rays through the slit at S to the revolving mirror, R, thence through a hole in the shutter, through the lens, and to the distant mirror. The interior of the building was painted black. In a room underneath the part, R, was the apparatus which supplied the air for turning the mirror.

The heliostat was kindly furnished by Dr. Woodward, of the Army Medical Museum, and was a modification of Foucault's

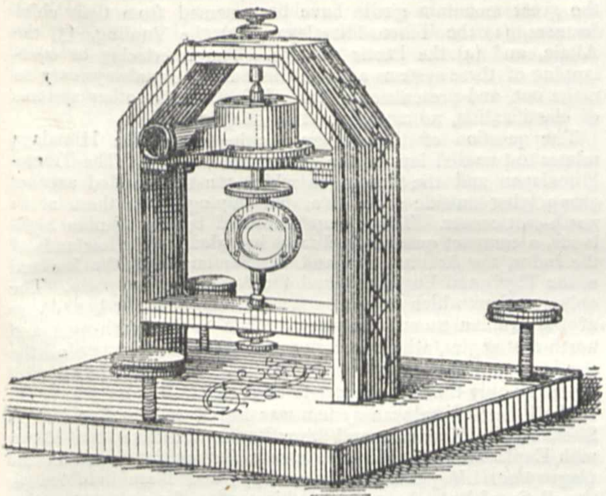


FIG. 4.

form, designed by Keith. It was found to be easy of adjustment and quite accurate.

The light was reflected from the heliostat to a plane mirror, M, Fig. 3, so that the former need not be disturbed after being once adjusted.

The revolving mirror was made by Fauth & Co., of Washington. It consists of a cast-iron frame, Fig. 4, resting on three levelling

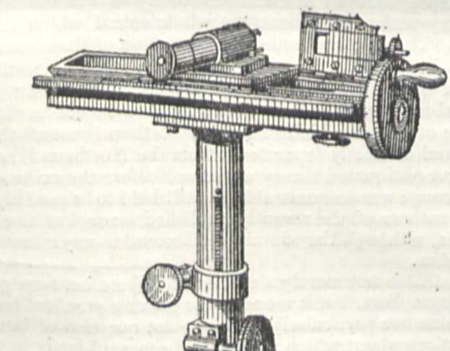


FIG 5.

screws, one of which was connected by cords to the table at S, Fig. 3, so that the mirror could be inclined forward or backward while making the observations. Two binding screws, terminating in hardened steel conical sockets, hold the revolving part. This consists of a steel axle, the pivots being hardened, expanding into a ring, which holds the mirror. The latter was a disc of plane glass, made by Alvan Clark, about one and a quarter inch in diameter and 0·2 inch thick. It was silvered on one side, the reflection taking place from the silvered side. A species of turbine wheel is held on the axle by friction. This wheel has six openings for the escape of air. The air entering on one side acquires a rotary motion in the box, carrying the wheel with it, and this motion is assisted by the reaction of the air in escaping. The disc above the mirror serves the purpose of bringing the centre of gravity in the axis of rotation. This was done, following Foucault's plan, by allowing the pivots to rest on two inclined planes of glass, allowing the arrangement to come to rest, and filing away the lowest part of the disc; then trying again, and so on, till it would rest in indifferent equilibrium. The part corresponding to the disc in Foucault's apparatus was furnished with three vertical screws, by moving which the axis of figure was brought into coincidence with the axis of rotation. This adjustment was very troublesome, and in this apparatus was found unnecessary. When the adjustment is perfect the apparatus revolves without giving any sound, and when this is attained the motion is regular and the speed great. A slight deviation causes a sound, due to the rattling of the pivots in the sockets, the speed is very much diminished, and the pivots commence to wear. In Foucault's apparatus oil was furnished to the pivots, through small holes running through the screws, by pressure of a column of mercury. In this apparatus it was found sufficient, at high speed, to touch the pivots occasionally with a drop of oil.

The quantity of air entering could be regulated by a valve,

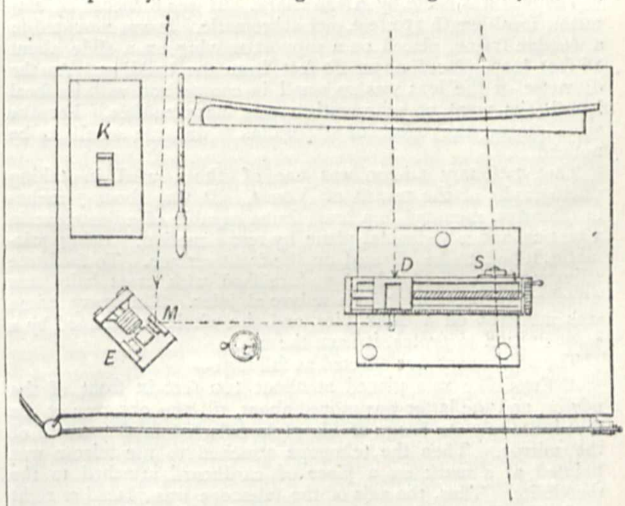


FIG. 6

to which was attached a cord leading to the table. The revolving mirror was mounted on a brick pier.

The apparatus for measuring the deflection was made by Grunow, of New York.

It consists of a screw, with divided circle, Fig. 5. To the frame is attached an adjustable slit. On the screw travels a carriage which supports the eyepiece, which consists of an achromatic lens, having in its focus at the end of the tube a single vertical silk fibre.

Next the eye is a piece of plane glass, inclined at an angle of 45°. In measuring the deflection, the eyepiece is moved till the cross hair bisects the slit (with which it is nearly in the same plane), and the reading of the scale and divided circle gives the position. This is made once for all, unless the slit be altered in width or position. Then the eyepiece is moved till the cross hair bisects the deflected image of the slit; the reading of scale and circle are again taken, and the difference in readings gives the deflection. The screw has no lost motion, so that readings may be taken with the screw turned in either direction. This apparatus is mounted on a standard with rack and pinion, and the base furnished with levelling screws.

To regulate and measure the speed of rotation, a tuning-fork, bearing on one prong a steel mirror, was employed. This was kept in vibration by a current of electricity from five gravity cells. The fork was so placed that the light from the revolving mirror was reflected to the piece of plane glass in the eyepiece, thence reflected into the eye. When fork and revolving mirror are both at rest, the eye sees an image of the revolving mirror.

When the fork vibrates, this image is drawn out into a band of light. When the mirror commences to revolve, this band breaks up into a number of moving images of the mirror; and when, finally, the mirror makes as many turns as the fork makes vibrations, these images are reduced to one which is stationary. This is also the case when the number of turns is a sub-multiple. When it is a multiple, or a simple ratio, the only difference is that there will be more than one image.

Hence, to make the mirror execute a given number of turns, all that is necessary is to pull the cord attached to the valve, to the right or left, till the images of the revolving mirror come to rest.

The electric fork made about 128 vibrations per second. No dependence was placed upon this rate, however, but at each set of observations it is compared with a standard Ut_3 fork, the temperature being noted at the same time. In making the comparison the beats were counted for 60 seconds.

It is interesting to note that the electric fork, as long as it remained untouched and at the same temperature, did not change its rate more than 0·01 or 0·02 vibration per second.

Fig. 6 represents the table at which the observer sits. The light from the heliostat passes through the slit at S, goes to the revolving mirror, etc., and on its return forms an image of the slit at D, which is observed through the eyepiece. E represents the electric fork, bearing the steel mirror, M; K, the standard fork on its resonator.

The lens was made by Alvan Clark. It was 8 inches in diameter, focal length 150 feet, not achromatic. It was mounted in a wooden frame, placed on a support moving on a slide about 16 feet long, placed about 80 feet from the building. As the diameter of the] lens was so small in comparison with its focal length, its want of achromatism was inappreciable. For the same reason the effect of "parallax" was too small to be noticed.

The stationary mirror was one of those used in taking photographs of the transit of Venus. It was about 7 inches in diameter, mounted in a brass frame capable of adjustment in a vertical and a horizontal plane by screw motion. Being prismatic, it had to be silvered on the front surface. To facilitate adjustment, a small telescope furnished with cross hairs was attached to the mirror by a universal joint. The heavy frame was mounted on a brick pier, and the whole surrounded by a wooden case, to protect it from the sun.

The adjustment was effected as follows:—

A theodolite was placed at about 100 feet in front of the mirror, and the latter was moved about, till the observer at the theodolite saw the image of his glass reflected in the centre of the mirror. Then the telescope attached to the mirror was pointed at a mark on a piece of cardboard attached to the theodolite. Thus, the axis of the telescope was placed at right angles to the surface of the mirror. The theodolite was then moved to 1,000 feet, and, if found necessary, the adjustment repeated. Then the mirror was moved till its telescope pointed at the hole in the shutter of the building. The adjustment was completed by moving the mirror by signals, till the observer, looking through the hole in the shutter through a good spyglass, saw the image of the glass reflected centrally in the mirror.

Notwithstanding the wooden case about the pier the mirror would change its position between morning and evening, so that the last adjustment had to be repeated before every series of experiments.

(*To be continued.*)

ON THE MOUNTAINS OF THE NORTHERN AND WESTERN FRONTIER OF INDIA[1]

THERE are certain moot questions relating to the mountains of the north-west frontier of India upon which it appears desirable to elicit the opinion of geographers. On this occasion I propose to discuss the western limits of the Himalaya; the northern and southern limits of the Hindu Kush; the parallelism and lateral communications of the ranges between the Hindu Kush and the Aralo-Caspian plain and of other parts of the north-west frontier; and the limits of the Iranian group of highlands, at its junction with the Tibeto-Himalayan and Pamir groups. Finally the proper route of a railway to India between Mesopotamia and the Indus is indicated along a remarkable line of elevated valleys parallel to the coast.

[1] Paper read at the Sheffield meeting of the British Association by Trelawney W. Saunders.

The Himalaya ranges form a part of the great girdle of mountains which continuously encircle the central portion of the Asiatic Continent, and include the Chinese colonial dependencies of Ili, Mongolia, Kokonor, and Tibet.

This vast mountain girdle is naturally grouped into four parts corresponding with the outlets of its exterior drainage according to their connection with the Arctic, Pacific, and Indian Oceans, and the Aralo-Caspian Seas respectively. These four divisions of the great mountain girdle have been named from their chief features, (1) the Tibeto-Himalayan, (2) the Yunling, (3) the Altaic, and (4) the Pamir systems. The interlacing or overlapping of these systems at their junctions is not always easy to make out, and presents occasional difficulties like other systems of classification, no matter what the subject may be.

The question of the western termination of the Himalaya relates to two divisions of the great girdle, namely, The Tibeto-Himalayan and the Pamir, to which must be added another group lying outside those two, but impinging on them at its north-east corner. This group is formed by the Iranian highlands, a compact quadrilateral mass bounded by the lowlands of the Indus, the Arabian Sea and the Persian Gulf, the lowland of the Tigris and Euphrates, and the Aralo-Caspian plain. The only questions which can well arise with regard to the boundaries of the Iranian mountain system, relate to its north-west and north-east angles, where it unites with the Tauric system on the one hand and the Himalaya and Pamir on the other. It is with the latter only that we propose to deal now.

My Tibeto-Himalayan system was introduced in 1870 in "A Sketch of the Mountains and River Basins of India in two Maps, with Explanatory Memoirs." It was further developed in the *Geographical Magazine*, for July, 1877; and I am indebted to the distinguished chairman of this section for an appreciative account of it in two editions of his "Memoirs of the Indian Surveys in 1871 and 1877." It resolves the leading features of the vast mass of which it treats into four great chains with their outer slopes and intermediate valleys or plateaus. I am obliged to allude briefly to this bygone work, for the purpose of forming a logical basis for the argument which follows.

The northern and southern Himalaya are two of these great chains. The Karakorum-Gangri and the Kuenlun are the other two. The Southern Himalaya rises from the great plain of India, and its culminating summit is distinguished by an extraordinary chain of snowy peaks throughout the whole extent which is claimed for it. The catenary and close succession of these snowy peaks cannot be denied, for they have been fixed in position and altitude by the indubitable observations of the great Trigonometrical Survey of India. Nor can the existence be disputed of the line of valleys which forms the northern base of this snowy range and distinctly separates it from the Northern Himalaya.

Yet an antiquated theory conceived before the existence of this snowy range was demonstrable, is still held to be possibly tenable by the authors of the recently published manual of the Geology of India, although they do not condescend to any reason for their conclusion.

Now this is not merely a matter of dispute between geologists and geographers, but it is one of the greatest practical importance with reference particularly to the potent question of lateral communications about which much has been said lately in reference to the Iranian system in Afghanistan. In the successive valleys following one after the other in the same line, each of which I have specifically named in the *Geographical Magazine*, there is indisputable evidence of the separation of the two ranges, and of that lateral communication which is an ordinary feature of mountain systems, rather than otherwise.

The Northern Himalaya has its southern base in these valleys, while its northern base is found in the extended trough along which flows the upper courses of the great rivers Indus, Sutlej, and Sanpu.

It is usually said that the Himalaya extends up to the gorge of the Indus on the west and to the gorge of the Sanpu on the east, and this is the extent assigned to the Himalaya by the authors of the "Manual of the Geology of India." But this restriction falls short of the limits which we have already assigned to the Tibeto-Himalayan system, on the basis of the natural oceanic watersheds. It also falls short of the extension attributed to the Himalaya on the west by observers and geographers of celebrity; and we shall endeavour to prove that it falls short, on the west at least, of the plain and simple application of the same conditions as those on which the Himalaya is allowed to extend up to the gorge of the Indus.

The valley of the Upper Indus running from south-east to north-west, at the northern base of the Northern Himalaya, and between the Northern Himalaya and the Karakorum Mountains, is carried forward in the same direction by the valley of the Gilgit river up to Yassin, and thence over a relatively low water-parting into the upper valley of the Kunar river. Near the confluence of the Indus with the Gilgit, the Indus makes a rectangular bend on entering the gorge through which it intersects both ranges of the Himalaya to enter the plain of Peshawur. But the range of the Northern Himalaya which, it is allowed, dominates the left bank of the Indus as far as the gorge, does not cease there, but is continued across the Indus in the same direction as before, and proceeding westward forms the southern barrier of the Gilgit, Yassin, and Chitral valleys, until it meets the Hindu Kush on the west of the Kunar river. The separation of the Hindu Kush from the Himalaya will be discussed further on. The valleys of Gilgit, Yassin and Chitral, in which the base of the Northern Himalaya is found, are indeed a prolongation of the great trough which forms its northern base throughout. At the extremity of the Himalaya the Kunar river drives a passage through a gorge which remains unexplored, although it is probably not less accessible than the gorge of the Indus with which we have only recently been made acquainted.

Having now traced the Northern Himalaya up to the Hindu Kush, the continuation of the Southern Himalaya west of the gorge of the Indus remains to be made out. It is defined by a series of peaks fixed by the Trigonometrical Surveyors in a line from that gorge up to the southern end of the Kunar gorge. Beyond the Kunar, the line of peaks bulges southward and bends again northward following the base formed by the Kunar, the Kabul and the Panjshir valleys, till it meets the Hindu Kush. Like the rest of the peaks of the Southern Himalaya, the peaks west of the Indus form the culminating summits of the southern slope which ascends in unbroken continuity along the whole extent of the Indian lowland, from the eastern extremity of the valley of Assam to the plain of Peshawur, and the line of the Kabul river. Lieut. Wood, the explorer of the Oxus, who as surveyor accompanied Sir Alexander Burnes' famous mission to Kabul, remarks that "the Himalaya, as is well known, bounds Hindustan on the north, and after crossing the river Indus, extends westward to the valley of Panjshir." The Trigonometrical surveyors have since defined the exact position of the great peaks which mark the culminating summit of the range along its whole extent. At the present time, we have still to await the exploration of the high ground between the northern and southern ranges west of the Indus. There is little doubt that it will be found to correspond with the rest of the interval between the ranges throughout their extended course.

We may now turn to the Hindu Kush. The ends of the axis of the Hindu Kush are well defined as that axis is the water-parting between the basins of the Indus and the Oxus. Its southern base is to be sought in the same line of watercourses which define the northern base of the Northern Himalaya with the addition westward of the Ghorband valley. The known parts of this line include the Ghorband and Panjshir valleys, and the Upper Kunar in Chitral. It remains for future exploration in Kafiristan to trace out a line of lateral valleys serving to connect the Panjshir with the Upper Kunar, in order to complete the line of contact and division between the Hindu Kush and the Northern Himalaya.

The northern base of the Hindu Kush may be traced from Bamian along the Surkhab to its junction with the Anderab valley, from the head of which, I have little doubt, a line of lateral valleys will be found connecting Anderab with Kuran, Zebak, the Panja, and the Sarhad-wakhan or southernmost head of the Oxus.

The division between the Hindu Kush and the Himalaya is, so far as it goes, likewise the division between the Tibeto-Himalayan system and that of the Pamir. To complete the division of the latter systems we must find a line of watercourses from the Kunar river up to the Tagh Dumbash Mountain, which marks the common termination of the Karakorum and the Hindu Kush; and from the Tagh Dumbash Mountain the dividing line of the two systems must be carried down to the plain of Yarkand by an affluent of the Yarkand river.

The Pamir group of mountains has the southern base of the Hindu Kush for a part of its southern limit. Its western base is in the plain of Gobi between the Yarkand and Kashgar rivers. Its northern base is in the plain of Kokand or Ferghana, watered by the Syr Daria or Jaxartes of the ancients. The western base strikes southward along the foot of the mountains; crosses the Zarafshan river and passes Bokhara; after which the group bends round to the eastward and finds its southern base along the right bank of the Oxus, up to its outlet from the mountains; then it follows the mountains crossed by the Lataband Pass, to the Akserai or Surkhab river, which it ascends to Bamian and Ghorband, where the continuation of the southern base of the Pamir group is found in the southern base of the Hindu Kush, as already mentioned.

We have heretofore defined the indisputable limits of the great quadrilateral Iranian group, and while the recollection of the limit of the Pamir along the course of the Surkhab or Akserai to Bamian and Ghorband, is fresh upon us, we will at once point to the same line as defining the separation and the contact of the Iranian and Pamir groups. From Ghorband by the line of the Kabul river to the Indus, is also traced, the separation and the contact of the Iranian with the Himalayan group. We cannot see that a more distinct or better limitation can be suggested for these important items of geographical nomenclature.

The principal ranges in the Pamir group are now fairly made out by British and Russian observers. The most easterly range is that of the Western Kuenlun, which rises in the plain of the Gobi above the cities of Yarkand and Kashgar, and culminates in snowy peaks, of which Togarmah is 25,500 feet in height above the sea, and Tash-balik is 22,500 feet. Westward of the Kuenlun range is the water-parting between the basins of Lake Lob and of the Oxus, a range which is in continuation with the Karakorum and Hindu Kush, and the meeting of the three is at Tagh Dumbash. This range was long since pointed out by that grand geographer Baron Humboldt, and was identified by him with the Bolor of Oriental writers. An attempt has been made by a mistaken Russian geologist and some of his followers, and also by a critic distinguished for another reason, to do away with this well established and distinctive name; but such a feature parting two famous river basins and connecting other great ranges cannot go unnamed; and we contend that the name rendered classical by the labours of Alexander Humboldt, ought to be maintained. This Bolor range is separated from the Kuenlun by a series of valleys with streams that descend to the Gobi, including the Kizilyart Plain in the northern part, while in the southern part the repetition of the name Tagharmah is probably connected with the ancient Toghari, or Tochari. The Bolor range also forms the eastern limit of the Pamir or Roof of the World, a lofty plateau rich in summer pastures, drained by the Oxus and its affluents, and bounded on the west by another great range named Khoja Mohammed.

If we compare this part of the Pamir system with the western Himalaya, a certain similarity will be observed. Thus the Upper Oxus between the Khoja Mohammed and Bolor ranges, flows at an altitude similar to that of the Upper Indus, between the Northern Himalaya and the Karakorum ranges, or about 10,000 feet. West of the Khoja Mohammed range, is the range crossed by the Lataband pass, the latter separating the lowland of Kunduz from the elevated valley of Lower Badakshan, just as the southern Himalaya separates the elevated valley of Kashmir, from the lowland of the Punjab.

Lieut. Wood represented the Khoja Mohammed range as extending from the great bend of the Oxus to the Kokcha or river of Badakshan, and beyond that river in a south-westerly direction, that is, nearly parallel with the Hindu Kush. We shall consider its further extension presently. Similarly the Lataband range must be regarded as extending all along the Aralo Caspian plain from Kunduz to the Caspian Sea, and along the south of that sea to the Armenian plateau. Like the southern Himalaya it has its outer base in the great plain, but the inner base, has so far only been made out at intervals, and is an object that well deserves observation with reference to the existence of natural facilities for lateral communication along the side of the highland.

In pursuing this interesting subject we have to point to two well determined parallel lines already set out forming respectively the great waterparting and the base in the plains. The waterparting in question is formed in continuation of Karakorum westward, (1) by Hindu Kush, between the Oxus and Indus basins; (2) by Koh-i-Baba between the Oxus and Helmund basins; (3) by Siah Koh between the Murghab and Helmund. We will not pursue the culminating line further at present. A succession or chain of lateral valleys follows we believe both sides of this summit. On the north side we follow the Upper

Oxus as far as it flows parallel with the Hindu Kush; then cross over the pass of Ishkashm to the Upper Kokcha from which in all probability the Anderab valley is accessible, and also Bamian. From Bamian Capt. Conolly passed to the upper waters of the river of Balkh and thence into the valley of Hari Rud, which expands westward to the meridian of Herat.

Between the meridian of Herat and Kabul, at least three lines of lateral communication are partially delineated. These are the parallel valleys of the Hari Rud, of the Murghab, and of the route traversed by Vambery, and the Russian officer Grodekov. Indeed it can be still further demonstrated that practical lateral communication exists throughout the whole length of the Iranian and Himalayan systems, and probably offers greater facilities of transit than the transverse routes.

On this point a few words appear to be called for, by the statements of a recent writer, a member of parliament, and formerly an Indian Governor of great distinction, who has denied the existence of lateral communication along and within the Suliman Mountains which form the easternmost part of the Iranian system and extend nearly from the Kabul River to the sea.

So far from lateral communication being wanting in this locality, which is now of much importance on account of its being brought by treaty within the scope of British administration—so far from the lateral communication being deficient and much less altogether absent—it constitutes as in the other mountains which we have discussed, a characteristic and marked feature of them. Indeed the outermost slope or scarp of the eastern Suliman has been delineated like a rising series of parallel gutters, terraces, or troughs, in the beautiful maps of the Derajat prepared by the surveyors under the guidance of Major-General Sir Henry Thuillier, who for so long a time filled the office of Surveyor-General of India, and whose presence here is such an advantage to the section.

In the heart of the mountains two lines of lateral communication can be already traced, even with our present very scanty information. Both are on the east of the waterparting of the Helmund and Indus basins, which is formed by the western range of the Suliman. One skirts the very summits of the range and is formed at its northern limit by the uppermost valleys of the Kurram, west of the Peiwar Kotul. It is watered by a stream which descends from near the Shutargarden Pass to the Kurram, where it meets another branch of the Kurram coming from the Mangal country on the south-western limits of the Kurram basin. From thence there is a communication with the district of Furmul which was known to the Turki Emperor, geographer, and conqueror of India—the famous Baber. Furmul lies at the head of the Dawar valley and river, which descends from it straightway to the Indus, but has never yet been wholly traversed by Europeans. Furmul is occupied by the Karoti tribe of the famous Povindah merchants, unless the Waziri have driven them out.

From Furmul this lateral line passes on to the Dwa Gummul another haunt of the Karoti people, who, as Povindahs and periodical visitors and traders to India, should have a clear interest in being friendly with us. From the Dwa Gummul we pass on to a southern headwater of the Gummul, and so on to the head of the Zhob valley, which is connected with the Thal-Chotiali route to Peshin.

There is another very important lateral line, a part of which was made known to Lieut. Broadfoot of the Royal Engineers as far back as 1842, by a native name, signifying "the road of the Waziri," a dominant tribe in those parts. This also connects the Kurram valley with the Dawar and Gummul valleys; and it is prolonged from Gummul up to the Chotiali route, by the great Zhob valley, which has at least been distinctly seen from both ends, in a direction nearly meridianal. We all know the great road which has been traversed by British troops between Kabul, Ghazni, Kandahar, and Kelat, and eastward of this, on the western side of the western Suliman range, a route has been traversed from Zurmul to lake Abistada, and from the lake to Kelat, British troops have marched over the Toba highland.

So much by way of proof of abundant lateral communication along the mountains west of the Indus.

One word more relating to the lateral communication through the hills and valleys of the south slope of the great Iranian highland. For it relates to the construction in the near future of a railway to India. From sheer ignorance some have proposed to carry such a line along the coast in a deadly climate with the atmosphere of a permanent hot bath. But the true route is found in one of those elongated lateral valleys which at a considerable elevation above the sea and in a better climate than that of the lowland on the coast, stretch all along from the Pubb river on the borders of India to Mesopotamia. Among these is the line of the Kej valley and a succession of others leading to Shiraz, from whence there is little doubt that a practical line may be found up to Bagdad.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Professorship of Experimental Physics has been formally continued by the Senate, and there is now no doubt that if Lord Rayleigh is willing to undertake this onerous office, he will be elected Professor. A memorial requesting him to be a candidate signed by almost every elector in a very short time seems like a command. It shows that there is no fear, and every hope for a beneficial result to education following. Lord Rayleigh's knowledge of the working of the University and the Scientific Commission will give him a most commanding position. It is a clear "call" from the University when such men as Adams, Besant, Cayley, Dewar, Ferrers, Frost, Garnett, J. W. Glaisher, Hughes, Liveing, R. K. Miller, Peile, Pendlebury, Routh, Salvin, Skeat, Stoke, James Stuart, Todhunter, Venn, James Ward, W. Aldis Wright and others unanimously record their view that it would tend greatly to the advance of physical science and to the advantage of the University that Lord Rayleigh should occupy the chair of Experimental Physics at Cambridge.

Messrs. C. W. Moule (Corpus) and S. H. Vines (Christ's) have been appointed members of the Botanic Garden Syndicate till November 20, 1882; Drs. Power and Phear have been appointed on the Museum and Lecture Rooms Syndicate; Mr. Henry Sedgwick and Mr. V. H. Stanton are again on the Local Examinations Syndicate; Messrs. W. D. Niven and G. H. Darwin are appointed on the Observatory Sydicate; Messrs. Bradshaw, Bensly and Peile, and Dr. Hart and Mr. Aldis Wright are on the University Press Syndicate; the two latter are special elections in view of the publication of the Revised Translation of the Bible; P. T. Main and F. M. Balfour on the State Medicine Syndicate.

Mr. S. H. Vines is also appointed on the Natural Science Studies; and Dr. Paget has been elected on the Council of the Senate, as a Professor, in Prof. Maxwell's place, for one year, and by only one vote over Prof. Stuart. Dr. Paget has on previous occasions been unwilling to come forward for such an onerous post, and would hardly now have done so, but for the short term of office required, and the importance of the medical and natural science rearrangements at Cambridge demanding his aid if the University showed its confidence in him.

An amended schedule for 2nd M.B. Camb. to come into operation in June, 1880, as far as regards comparative anatomy differs from that at present in force in introducing *excretory* and *reproductive* organs, as being required to be known in addition to the other principal systems: the tapeworms parasitic in man, cockroach, fresh-water mussel, whiting, and rabbit are introduced, while the spider and the cockchafer, oyster, perch, and rat disappear. In the specification as to the vertebrate skeleton, the cod displaces the perch, the dog replaces the rat. These changes all seem to be in the direction of providing larger and more conspicuous and accessible specimens to be studied, or those more necessary for a medical student.

SCIENTIFIC SERIALS

Journal of Botany, September, October, and November.—The last three numbers of this journal are mainly occupied with articles on descriptive and systematic botany, extracts, and reviews, with the exception of two, to which special attention may be called.—In the September number Mr. S. Le M. Moore has a "preliminary notice" on mimicry of seeds and fruits, and the functions of seminal appendages. He points out the number of seeds or fruits that bear a striking resemblance to coleopterous or other insects, by means of which he believes they may often escape from their seminivorous enemies by being passed over as insects, or, being picked up and thrown away by insectivorous birds, may thus become disseminated. He adduces striking instances of this mimicry in Polygalaceæ, Leguminosæ, Umbelliferæ, and especially Euphorbiaceæ, in which the caruncular of the seed closely resembles the head of the insect, and the raphal line the line between the closed clytra, the seed being often besides symmetrically striped or spotted. The main object of the fleshy caruncul us has been generally assumed to be the supplying of food to the young embryo; but this, Mr. Moore believes, is not confirmed by actual experiment. It also no doubt serves to attract seminivorous birds, through whose body the seed passes to be prepared for germination.—In the November number Mr. S. H. Vines has an article on alternation of generations in Thallophytes, the main object of which, however, is to show that it does not exist, except in a very few cases. This is indeed in accordance with the general view of botanists. Mr. Vines still holds to his view that alternation of generations occurs in Characeæ; though why he now returns to the very doubtful position which he had previously abandoned, that the Characeæ are Thallophytes, is not explained.

Nuovo Giornale Botanico Italiano, October.—Sig. Borzì continues his series of papers on the morphology and biology of the Phycochromaceæ, the present portion being devoted to the structure and classification of the Scytonemaceæ, which he makes to consist of seven genera, viz., Coleodesmium, Bzl.; Tolypothrix, Ktz.; Hilsea, Kirchn.; Scytonema, Ktz.; Stigonema, Ag.; Capsosira, Ktz.; and Hapalosiphon, Näg. The various modes of increase he defines to be (1) by pseudoramuli, or portions of filaments which deviate from the ordinary direction, heterocysts being sometimes interposed between these and the filament from which they spring; (2) by spontaneous fraction of the filaments, the different portions remaining united in a bundle within a common gelatinous envelope, where they increase independently; (3) by hormogonia, or fragments which become detached from the filament, and which move slowly in the water in a rectilinear direction, light exercising no influence on the movement; (4) by spores, or isolated cells capable of resisting cold and excessive drought. In the same number A. Bertolini describes a new disease of the cherry-laurel, caused by a parasitic fungus, to which he gives the name *Oidium passerinii*, and which attacks the fruit. It makes its appearance in the form of irregular white spots, composed of filaments which invest the epicarp of the fruit, and from which rises a delicate down. The former is the mycelium of the fungus, the latter consists of the ovoid conidia arranged in moniliform filaments.

THE *Revue Internationale des Sciences* (September) contains the following among other papers:—The plant and man in their reciprocal relations, by Dr. Ernest Hallier.—On the geology of the Japanese Archipelago, by M. G. Maget.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 20.—"On Definite Integrals involving Elliptic Functions." By J. W. L. Glaisher, F.R.S.

"Values of the Theta and Zeta Functions for certain Values of the Argument." By J. W. L. Glaisher, F.R.S.

"On Certain Definite Integrals." No. 5. By W. H. L. Russell, F.R.S.

"On the Action of Nuclei in Producing the Sudden Solidification of Supersaturated Solutions of Glauber's Salt." By Charles Tomlinson, F.R.S.

"The Geometric Mean, in Vital and Social Statistics." By Francis Galton, F.R.S., and Donald McAlister, B.A., B.Sc., Fellow of St. John's College, Cambridge.

"On the Normal Paraffins. Part III." By C. Schorlemmer. F.R.S., Professor of Organic Chemistry in Owens College, Manchester.

Zoological Society, November 18.—Prof. Flower, F.R.S., president, in the chair.—An extract was read from a letter addressed to the Secretary by Mr. H. O. Forbes, on the subject of the distribution of the badger-headed Mydaus in Java.—The Secretary read an extract from a letter received from Dr. A. B. Meyer, in which the habitat of *Cervus alfredi* was stated to be Samao and Leyte Islands, of the Philippine group.—Mr. Edward R. Alston exhibited some mammals collected by Mr. Wardlaw Ramsay, 67th Regiment, including examples of some species new to the faunas of Burma and Afghanistan.—Mr. Alston also exhibited one of the typical skulls of *Tapirus dowi* (Gill), which had been entrusted to him by the authorities of the U.S. National Museum. He remarked that the young tapir from Corinto, Nicaragua, which was formerly alive in the Society's Gardens, was really an example of *T. dowi*, and not, as had been hitherto supposed, of *T. bairdi*.—Prof. Flower exhibited and made remarks upon the skull of a White Whale (*Delphinopterus leucas*), recently obtained in Sutherlandshire.—The Secretary exhibited on behalf of Mr. Rowland Ward, the head of a chamois, with two pairs of horns.—Communications were read from Mr. L. Taczanowski, C.M.Z.S., containing descriptions of a new *Synallaxis*, from Peru, which he proposed to name *Synallaxis fruticola*; and of a new *Myiarchus*, from the same country, proposed to be called *M. cephalotes*.—A third communication received from Mr. Taczanowski contained a notice of some birds of interest recently received from Turkestan.—A communication was read from Captain Shelley, containing an account of a collection of birds made in the Comoro Islands, received from Dr. Kirk, H.B.M. Consul-General at Zanzibar. The collection contained 186 specimens. A *Zosterops* which appeared to be new was named *Z. kirkii*, in acknowledgment of the assistance rendered to ornithology by Dr. Kirk.—A second paper by Captain Shelley, gave the description of two new species of African birds.—Lieut.-Col. H. H. Godwin-Austen, F.Z.S., read a description of the female of *Lophophorus sclateri*, Jerdon, from Eastern Assam.—A communication was read from Dr. Goodacre, F.Z.S., on the question of the identity of the common and Chinese geese.—A communication was read from the Rev. O. P. Cambridge, C.M.Z.S., on some new and rare spiders from New Zealand; with characters of four new genera.—A communication was read on some African species of Lepidoptera, belonging to the sub-family, Nymphalinæ, by Mr. W. L. Distant. In this paper several instances of great variation were given, and some corrections made in the nomenclature. A new genus, five new species, and the male of *Halma lucasi*, Down, were also described.—Mr. R. G. Wardlaw Ramsay read the description of a new oriole, from N. E. Borneo, which he proposed to call *Oriolus consobrinus*.

Royal Microscopical Society, November 12.—Dr. Beale, F.R.S., in the chair.—Ten new Fellows were elected and eleven proposed for election at the next meeting. Prof. Weismann and others were elected Hon. Fellows.—A paper by Mr. H. E. Forrest, on the anatomy of *Leptodora hyalina*, was read; also papers by Mr. J. Fullagar, on a supposed new species of freshwater *Freia*; by Col. Woodward, on amplifiers and the use of chloride of cadmium and glycerine as a fluid for homogeneous immersion, and by Mr. J. Mayall, jun., on his immersion stage illuminator, which was exhibited to the meeting. Among the objects exhibited were anomalous forms of *Acinetæ*, by Mr. Badcock, an improved micratome, by Mr. Ward; various algæ and infusoriæ, by Mr. Bolton, a new compressorium, by Mr. Graham, and Zeiss's travelling-microscope, by Mr. Crisp.

Anthropological Institute, November 11.—E. B. Tylor, F.R.S., president, in the chair.—The following new Members were announced:—A. Tylor, F.G.S., Baron von Hugel, Capt. R. C. Temple, and G. W. Bloxam, F.L.S.—Mr. E. W. Brabrook, secretary to the Anthropometric Committee, exhibited two albums of photographs collected by that body.—A report on the Bheel tribes of the Vindhyon Range was read by Col. Kincaird, fully describing the manners, customs, and superstitions of these little-known people, from experience derived during many years' residence amongst them. The Bheels are very dirty in their habits: their principal diseases are enlarged spleen and small-pox.—A paper was read by Mr. A. H. Keane on the relations of the Indo-Chinese and inter-oceanic races and languages, to show that Further India is occupied by two types, the fair and the yellow (Caucasian and Mongolian), the former speaking polysyllabic-untoned, the latter monosyllabic toned, languages; that both of these types, intermingled with the Papuan or dark races, constitute the whole of the population of Malaysia; that the Caucasian alone appears in the Eastern Pacific as the "*Sawaiori*," or "large brown Polynesian race." The absence of the monosyllabic languages from the oceanic area was accounted for, the expression "Malayo-Polynesian" shown to be misguiding, and the Malay type itself was considered to be, not fundamental, but essentially mixed—the result of fusion in the Eastern Archipelago of the fair and yellow elements.—Mr. S. E. Peal exhibited a fine collection of ethnological drawings made in Assam.

VIENNA

Imperial Academy of Sciences, October 9.—The vice-president made reference to the deaths of Dr. Fenzl, of Vienna, and Dr. v. Brandt, of St. Petersburg.—The following among other papers were read:—Earthquakes in Canea on the night of August 9-10, by Herr Miksche.—On the decline of water in springs, rivers, and streams with simultaneous rise of high-water in cultivated lands, by Herr v. Wex.—Reply to Prof. Heer (with regard to the task of phyto-palæontology), by Prof. von Ettingshausen.—Further investigation of spark-waves, by Prof. Mach and Herr Simonides.—On rational plane curves of the third and fourth order, by Herr Ameseder.—On the development of back-vessels and specially of the muscular system in Chironomus and some other insects, by Herr Jaworowski.—Determination of altitude of the pole at the Observatory of the Technical High School in Vienna, by Dr. Tinter.—Studies on a plane conic section of rotation, whose parameters are of the same size, by Herr Rotter.—Discovery of two comets by Herr Palisa and Herr Hertwig.—On combinations from animal tar. II. Non-basic constituents, by Dr. Weidel and Herr Ciamician.—On the phenomena in Geissler tubes under external action (first part), by Prof. Reitlinger and Urbanitzky.—On a species of configurations in the plane and in space, by Herr Kantor.

Paris

Academy of Sciences, November 17.—M. Daubrée in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris Observatories during the third quarter of 1879; communicated by M. Mouchez.—On the temperature of decomposition of vapours, by M. Sainte-Claire Deville. He supports M. Berthelot's views in opposition to M. Wurtz. The quantity of heat liberated by formation of a compound substance has no known relation with its temperature of decomposition.—Observations on M. Cochin's note on alcoholic fermentation, by M. Berthelot.—Observation of the ultra-violet limit of the solar spectrum at different altitudes, by M. Cornu. Fifty-two *clichés* were obtained at three stations: Riffelberg (2,570 m. alt.), Rigi (1,650 m.), and Viège (660 m.) The extreme ultra-violet limits were, severally, λ 293·2, 294·8, and 295·4; the difference between Riffel and Viège (1,910 m.) being thus only 2·2 units (or millionths of a millimetre), or about 1 unit for 900 metres' altitude, a small amount of variation.—Explosion of carbonic acid in a coal-mine, by M. Delesse. This occurred in a coal-pit at Rochebelle (Gard), where there is much carbonic acid (no fire-damp). Two men at 345 m. depth heard two successive detonations (without flame), had their lamps blown out, became faint, and were just able to throw themselves into the cage, when they were pulled up. Three others, at 246 m. depth, perished. It is the first time the CO_2 has been so compressed and condensed in the coal as to cause explosion. Some seventy-six tons of coal were disengaged; and the CO_2 liberated is estimated at a maximum of 4,596 cubic metres. It is thought that a near stratified mass of iron pyrites being very strongly oxidised and decomposed, the resulting sulphuric acid dissolving in subterranean water reaches the triassic limestone, and so produces CO_2, which diffuses through the fissures of the coal. M. Dumas supported this view.—Second note on the effects and mode of action of antiseptics; effects on pus, by MM. Gosselin and Bergeron. Rightly used camphorised brandy, carbolic acid ($\frac{1}{50}$) and alcohol at 86° are, in the same degree, moderators of inflammation and preventives of septicæmia.—Climatological conditions of the years 1869-1879 in Normandy, and their influence on ripening of the crops (continued), by M. Mangon. In the north-west of La Manche, the low temperature of the end of 1878, of the first six months, and especially of July, 1879, and the abnormal rains of February and June, retarded the harvest about twenty-two days for corn, twenty for barley and beans, and ten to twelve for buckwheat. By noting the sum of degrees of temperature in each year since sowing, we may, with aid of the tables here given, calculate very exactly a month or six weeks in advance the time of harvest for the crops named.—On the true number of fundamental co-variants of a system of two cubics, by Prof. Sylvester.—Critical reflections on the experiments concerning human heat, by M. Hirn.—M. de Lesseps presented communications relating to a railway from Algeria to Senegal and Soudan, Belgian expeditions in Central Africa, and the public laws applicable to international rivers.—Atmospheric polarisation and the influence of terrestrial magnetism on the atmosphere, by M. Becquerel. He proves that a variable divergence exists between the plane of the sun (meaning thereby a plane passing through the observer's eye, the point looked at, and the centre of the sun) and the plane of polarisation of the atmosphere at any point, and thinks the influence of the earth's magnetism appears in rotating the plane of polarisation.—On a class of functions analogous to the Eulerian functions studied by M. Heine, by M. Appell.—New principle of meteorology furnished by an examination of earthquakes, by M. Delauney. Earthquakes seem to pass through a maximum when Jupiter and Saturn are about the mean longitudes of 265° and 135°. A recrudescence of earthquakes in winter the author attributes to streams of cosmic meteors, and the influence of Jupiter and Saturn in the positions stated to their passage through such streams.—Remarks on M. Boiteau's paper about winter eggs of phylloxera in surface-layers of the ground, by M. Balbiani.—On the causes of reinvasion of phylloxerised vineyards, by M. de Lafitte.—A telegram from General Ibanez announced completion of the geodetic connection of Spain with Algeria (November 16).—Observations of a satellite of Mars (Deimos) at Paris Observatory, by M. Bigourdan.—On doubly-periodic functions with singular essential points, by M. Picard.—Spots and protuberances observed with a spectroscope of great dispersion, by M. Thollon. The displacements and alterations of lines in observations of spots are specially striking. They are always in the same direction, and seem to indicate a motion from periphery to centre. A brilliant protuberance observed with narrow slit, illuminated vividly portions of the line C, which presented numerous solutions of continuity. The prodigious velocity of 25 km. per second indicated by the line, and lasting some time, suggests doubt as to the reality of the supposed cause.—The problem of the Euripus, by M. Forel. He traces the action of seiches as well as of soli-lunar tides in the currents of these straits.—On chlorophyll, by M. Gautier. He describes how he obtained chlorophyll pure and crystallised in 1877. He regards it as closely related to bilirubin, in aptitudes, reactions, and elementary constitution, and consequently to hematine.—Viviparity of *Helix studeriana* (Ferussac), by M. Viguier.—On the relative distribution of mean temperatures and pressures in January and July, by M. Teisserenc de Bort.—M. Le Bon gave some results of measurement of crania of eminent men in the Museum of Natural History. The high average figure of 1,732 cc. (capacity) was got from twenty-six skulls.—M. De Coiney described a meteor observed by day at Jevah (Dordogne).

CONTENTS