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THURSDAY, APRIL 27, 1871

## THE HOPE OF FRANCE

A PAPER which M. Henri Sainte-Claire Deville has recently laid before the Paris Academy of Sciences is in our opinion of such high importance that we make no apology for placing it in original before our readers. It runs as follows :—

"La science a joué un grand et terrible rôle dans les défaites que nous venons de subir. Les découvertes d'Ampère, les travaux de nos mécaniciens militaires ont été cruellement utilisés contre nous. Enfin, l'organisation libérale des universités allemandes a été mise au service de passions haineuses dirigées contre notre pays. Aussi dit-on de tous côtés et avec raison que c'est par la science que nous avons été vaincus. La cause en est dans la régime qui nous écrase depuis quatre-vingts ans, régime qui subordonne les hommes de la science aux hommes de la politique et de l'administration, régime qui fait traiter les affaires de la science, leur propagation, leur enseignement, et leur application par des corps ou des bureaux où manque la compétence et par suite l'amour du progrès.

"Aujourd'hui, messieurs, il est temps d'agiter publiquement les grandes questions. La réserve modeste pratiquée trop souvent par un trop grand nombre des membres de cette Académie serait une faute grave en ce moment, une faute sans excuse.

"Dans des temps calmes beaucoup d'entre nous avaient pu se ménager dans leurs cabinets ou leurs laboratoires cette vie studieuse rendue si douce et si facile par l'éloignement des hommes et de leurs débats intéressés. Il est de notre devoir aujourd'hui d'intervenir tous activement et directement dans les affaires du pays, et de contribuer de toutes nos forces à une régénération par le savoir dont la France exprime partout la nécessité.

"Dans les temps difficiles, le pays a trouvé chez les membres de cette Académie, et dans l'Académie tout entière, le dévouement absolu sur lequel il avait le droit de compter. Nos séances, si bien remplies pendant la durée du siége, en seront un témoignage mémorable. Ces services mêmes, l'autorité morale que nous devons à notre origine qui est l'élection de chaque membre par ses pairs, tout, messieurs, nous oblige de contribuer à cette régénération du pays par l'initiative de chacun, par l'action de la compagnie tout entière.

"J'ai donc l'honneur de proposer à l'Académie d'admettre à l'ordre du jour de ses séances les grandes questions du développement et de l'enseignement de la science en France et toutes les questions d'intérêt général qui concernent la science et les savants.

"Par exemple, la France possède de grands et glorieux corps scientifiques dont quelques membres ont constamment siégé dans cette Académie. Quel service nous rendrions, si nous pouvions faire dépouiller ces grands corps de l'enveloppe politique, administrative ou fiscale qui les étouffe, qui met en péril le recrutement de la science parmi eux et dans les écoles célèbres qui leur servent de pépinières.

"Je le répète; je demande à mes confrères d'élargir le cercle de ses communications et d'y faire entrer toutes les questions d'intérêt scientifique, de quelque ordre et de quelle que nature qu'elles soient, de quelque part qu'elles viennent.

"Des commissions choisies dans nos sections et quelquefois dans les autres classes de l'Institut, devraient préparer, résumer et rédiger au besoin comme des vœux ou des décisions académiques les délibérations de la compagnie.

"Sous cette forme nouvelle, qui exclut toute intervention dans les affaires du gouvernement (car les affaires d'instruction publique ne sauraient plus être politiques), nous ferons arriver les conseils de l'expérience et du savoir, et, j'espère, toutes les vérités utiles à la connaissance directe du pays tout entier."

It is not our purpose to inquire how true may be M. Deville's idea that the success of the German arms has been due to the more vigorous pursuit of science in Germany; but we may remark that it is certain that it is the distinct and emphatic belief of the most eminent scientific men of France: it is our clear duty, however, to inquire whether we are in a better condition in this matter than France was a year ago.

First. Are our men of science subordinated to place-seekers or politicians who, according to M. Deville, lack competence, and therefore the love of progress? It is a question even whether we have even reached this stage! In England there is absolutely no scientific organisation whatever, no minister whose duty it is to care one jot for science, no one man in office to whom either scientific instruction or the advancement of science is of the least interest—unless, perhaps, we except Mr. Lowe, and we all know in what point of view he from time to time turns from his more important avocations to deal with such questions.

So that on this point there is no comparison between the two countries. The French have an organisation, the working of which, according to their own showing, has been entrusted to incompetent politicians. We have no organisation whatever—which, perhaps, is a blessing, if we should be compelled to imitate the French plan—but we very often have to pay very dear for blessings, and this certainly is one which the sooner we get rid of the better.

Let us now pass from the disease to the remedy. M. Deville proposes that the French Academy should at once take up all large questions connected with the advancement and teaching of science (and we are glad to see that M. Deville does not put the cart before the horse, as is too much the fashion here) in order to liberate it from the political, administrative, and fiscal fetters which now paralyse it and to enable the country to make the most of every scientific idea or effort.

As we understand this proposal, M. Deville wishes that the Academy of Sciences should interest itself not only in abstract Science, and in the teaching of abstract Science, but in all the scientific inquiries or departments of all branches of the administration. To what extent interference is proposed in this latter case we have as yet no means of knowing, but it is easy to see that the further this goes the better it will be for the nation. Two matters which have recently occurred in England, to which we may refer parenthetically, will, we venture to think, strengthen our assertion. We shall not be contradicted when we state that if the Scientific Committee recently appointed by the Admiralty—a Committee which contains among its members Profs. Sir Wm. Thomson and Rankine—had been in existence when the *Captain* was built, instead of being appointed after that costly ship had simply turned bottom upwards because it was top heavy, we should now be the richer of a noble ship and five hundred men. And yet—and yet—we believe this Committee is only a temporary one. Take another case: A Commission was recently appointed to inquire into the Education of the Army. Was there a man of Science upon it? Certainly not. And what was one of the first

things that came out of that Commission's report? This, namely, that most of the teachers of Science in the Army Schools received notice to quit. England, on the high authority of Lord Northbrook, did not want a Scientific Army.

All this by the way. We have referred to these instances, in order to show that the various departments of the Administration want scientific control here as is in France—that M. Deville's suggestion is of value here as there.

Now, assuming that the suggestion is a vital one, or even that it is an important one, and that it is good for England as for France, and we shall gladly open our columns to a discussion on these points; the question arises—is it possible to adopt it here?

We are met at once by the different conditions of the French Academy of Sciences, and our own Royal Society. The Academy is a large paid body; our Royal Society is a small unpaid body, and the work, which M. Deville considers so necessary for the regeneration of France, and which many consider necessary for the salvation of this country, is no temporary or small affair. The labour would be great, enormously great at first, and, moreover. would be a never ending one. To impose such a labour as this on a private body, which was constituted for entirely different purposes, would simply be to destroy that private body altogether, and it would be both unwise and unjust for such a body to undertake it, unless each member had ample means and no occupation. so that all his time and energy might be devoted to the task.

We think, then, that for these and for other reasons, not far to seek, it is impossible for our Royal Society to play permanently the *rôle* here which M. Deville has suggested to the Paris Academy.

But here, at length, is a grain of comfort. We have in England, at the present moment, a body at work, which if the general ideas of the power entrusted to it be correct, may perform those very services for England which M. Deville so loudly calls for—a call which all men of science *d'outre manche* re-echo—in the case of France. We refer to the Royal Commission on Scientific Instruction and the Advancement of Science, on which body, we take it, has devolved just such a general overhauling of all matters scientific within these realms as M. Deville has proposed—a herculean task, but a noble one if done well, and a task which will not be well done unless it is indicated how England can be put in a position second to no other nation so far as Science is concerned, a position that she certainly does not occupy at present.

But supposing all this done, we must have something more. We must have some permanent machinery, and having this we must have the scientific men mindful, above all other things, of the interests of science, and then our politicians will hear no uncertain sound as to the merits or demerits of State aid to the higher education. A nation, as a distinguished foreign *savan* has recently said, must endow science until that nation stands first (1) in abstract Science, (2) in the applications of Science generally, and (3) in the amount of knowledge possessed by State servants of all classes. When she has achieved this point the question of continuing State aid may properly be discussed—not till then. To this let us add that apart from the question of State-aided Science that nation will stand highest which, in addition to the above conditions, calls into her councils her men of Science, and becomes a Science-aided State. EDITOR

## *PANGENESIS*

IN a paper, read March 30, 1871, before the Royal Society, and just published in the Proceedings, Mr. Galton gives the results of his interesting experiments on the inter-transfusion of the blood of distinct varieties of rabbits. These experiments were undertaken to test whether there was any truth in my provisional hypothesis of Pangenesis. Mr. Galton, in recapitulating "the cardinal points," says that the gemmules are supposed "to swarm in the blood." He enlarges on this head, and remarks, "Under Mr. Darwin's theory, the gemmules in each individual must, therefore, be looked upon as entozoa of his blood," &c. Now, in the chapter on Pangenesis in my "Variation of Animals and Plants under Domestication," I have not said one word about the blood, or about any fluid proper to any circulating system. It is, indeed, obvious that the presence of gemmules in the blood can form no necessary part of my hypothesis; for I refer in illustration of it to the lowest animals, such as the Protozoa, which do not possess blood or any vessels; and I refer to plants in which the fluid, when present in the vessels, cannot be considered as true blood. The fundamental laws of growth, reproduction, inheritance, &c., are so closely similar throughout the whole organic kingdom, that the means by which the gemmules (assuming for the moment their existence) are diffused through the body, would probably be the same in all beings; therefore the means can hardly be diffusion through the blood. Nevertheless, when I first heard of Mr. Galton's experiments, I did not sufficiently reflect on the subject, and saw not the difficulty of believing in the presence of gemmules in the blood. I have said (Variation, &c., vol. ii., p. 379) that "the gemmules in each organism must be thoroughly diffused; nor does this seem improbable, considering their minuteness, and the steady circulation of fluids throughout the body." But when I used these latter words and other similar ones, I presume that I was thinking of the diffusion of the gemmules through the tissues, or from cell to cell, independently of the presence of vessels,—as in the remarkable experiments by Dr. Bence Jones, in which chemical elements absorbed by the stomach were detected in the course of some minutes in the crystalline lens of the eye; or again as in the repeated loss of colour and its recovery after a few days by the hair, in the singular case of a neuralgic lady recorded by Mr. Paget. Nor can it be objected that the gemmules could not pass through tissues or cell-walls, for the contents of each pollen-grain have to pass through the coats, both of the pollen-tube and embryonic sack. I may add, with respect to the passage of fluids through membrane, that they pass from cell to cell in the absorbing hairs of the roots of living plants at a rate, as I have myself observed under the microscope, which is truly surprising.

When, therefore, Mr. Galton concludes from the fact that rabbits of one variety, with a large proportion of the blood of another variety in their veins, do not produce mongrelised offspring, that the hypothesis of Pangenesis is false, it seems to me that his conclusion is a little hasty. His words are, "I have now made experiments of trans-

fusion and cross circulation on a large scale in rabbits, and have arrived at definite results, negativing, in my opinion, beyond all doubt the truth of the doctrine of Pangenesis." If Mr. Galton could have proved that the reproductive elements were contained in the blood of the higher animals, and were merely separated or collected by the reproductive glands, he would have made a most important physiological discovery. As it is, I think every one will admit that his experiments are extremely curious, and that he deserves the highest credit for his ingenuity and perseverance. But it does not appear to me that Pangenesis has, as yet, received its death blow; though, from presenting so many vulnerable points, its life is always in jeopardy; and this is my excuse for having said a few words in its defence. CHARLES DARWIN

## THE NEW HOSPITAL OF ST. THOMAS

### II.

THE large wards of the Hospital contained in the several flats of the Blocks 2, 3, 4, 6, and 7 * are rooms of noble dimensions. In the second, third, and fourth floors, each ward is more than 100ft. long, 38ft. wide, and 15ft. high; and as this space is designed for the accommodation of twenty-eight patients, each patient will have more than 2,000 cubic feet of air to his own share, irrespective of change by ventilation. But the arrangements for warming and ventilation are also very complete and admirable. The entire building is, in the first instance, warmed to a certain extent by pipes which receive supplies of hot water from large boilers fixed in the basements of each block of building. These heating pipes are expanded into broad radiating coils here and there where immediate increase of warmth is desired. There are two of these radiating coils to each ward. But in addition to these, there are also in each three *open fire-places* situated in the central line of the floor, and sending circular iron chimneys or flues up through the ceiling. These columnar iron chimneys are, however, double. Each has an inner central pipe, and an outer investing sheath. The inner pipe carries up the smoke of the burning fuel; the outer case collects all the effete and used-up air of the chamber, and discharges it with the smoke at the outer orifice above the roof, the central heated pipe being an efficient cause of a steady up-cast. The final outflow of both smoke and impure air is by the square turrets, which are seen from the outside as a part of the ornamental finish of the roof. The fresh air is brought from the outer wall beneath the floors, and is discharged into the wards *through the heated casings* of the fire stoves and radiating coils. This double plan of warming, partly by radiating hot pipes, and partly by open fire places, is the very perfection of efficiency and comfort. Private residences in England are almost always uncomfortable in very cold weather, however liberal may be the consumption of fuel, because the larger and brisker the fires, the more intolerable are the indrafts of cold air. The cylindrical smoke pipes run straight up from basement to roof through the entire series of floors, so that when the flues require cleansing, a kind of plug is removed from the bottom of the pipe, and the entire accumulation of soot is brought down at once into one of the cellars of the basement, without causing any interference with the comfort or cleanliness of the several wards above.

There are nurses' chambers on either side of the entrance of each large ward; and at each side of the farther end corresponding turrets, or corner rooms, containing lavatories and baths on one side, and closets on the other with convenient little shoots, which are to convey the dust of sweepings and the soiled linen of the patients down at once to the offices in the basements. Near the nurses' chambers there is also a large square lift, worked by hydraulic power, to be used in conveying patients and supplies of all kinds, up and down between the projecting corners, or turrets (at *b b* on the plan). At the further extremity there is a most delicious open-air balcony looking over the cheerful river, with ready access to it from the windows of the wards.

Block No. 9, being designed for the reception of infectious and contagious diseases, is differently planned. There are smaller wards on each side opening from a central stair-case and landing. Between the Blocks 2, 3, and 4, and between 6, 7, and 8 (at *a*, *a*, on the plan) are low buildings rising in broken and ornamental form from the general line of the connecting corridor, which will be used for the residence of officers of the establishment. Connected with the upper part of these, there is a fine surgeons' operating theatre at each side of the building, one for males and the other for females. These are entered from the light and airy glazed corridor of the second floor, and have retiring-rooms for patient and surgeon, and a direct way to a pleasant open-air flat roof looking out over the river.

In communication with the great connecting corridor there is a perfect maze of offices and conveniences, approached by an accident-receiving porch abutting on the Lambeth Road. There are receiving-rooms for out-patients and for surgical cases and accidents, dispensaries, and a long range of small private rooms for the medical and surgical officers, clerks, and dressers. The Administrative Block, No. 1, is entered from the Westminster Bridge Road by two flights of steps, one leading to the private residence of the Treasurer of the Hospital, and the other to a large Council hall looking out by a balcony upon the river, and to Committee rooms and other offices, which are to be connected with the other departments of the establishment by lines of electric telegraph. The general entrance of the Hospital is from the Lambeth Road, leading to a spacious hall in the central block, No. 5, above which is the Chapel of the Hospital, a vaulted building of fine proportions and very chaste design. This block will be finished towards the river front, where it is set back or recessed from the line of the other blocks, by an ornamented face which looks out on an enclosed space or central court. From this court the prospect to the river is between the pillars of an open colonnade, bearing in the centre a group of sculptured figures, of which the chief will be the statue of Edward the Sixth, the royal founder of the Hospital.

Block No. 9 has much more the appearance of a church, or chapel, than the central building. It is of low elevation, compared with the other blocks, and has ornamental arched windows of large size; and at the corner there is a square tower, half steeple, half pagoda, which

* See plan in NATURE No. 63, p. 202.

is altogether suggestive of a campanile. It is only when the eye is carried along the general range of the buildings, and it is noted that this tower is simply the architect's contrivance for raising the chimney turret in the case of this lower erection to the same height as the chimney turrets of similar aspect on the higher blocks, that the idea dawns upon the observer that this building may have a very different purpose to perform than affording accommodation for religious worship and service. It is, indeed, a temple for the dead rather than for the living. It is properly the Museum and Medical Schools of the Hospital; and the lofty tower will be employed to waft the vapours of effete corporeal mortality well up into the purifying atmosphere. Its interior will be warmed by hot-water warmed air to feed the combustion of the open fires. This evil is entirely obviated by this plan of having half pipes and radiating coils, to cause a strong up-cast; and will gather the air from brick channels of escape which permeate all portions of the building. The most surprising thing about this terminal block of the Hospital is the vast amount of accommodation that has been got out of it by dint of good package and clever arrangement. It looks like a tolerable-sized chapel, and might really be no more, yet it really contains a very capacious Museum, four large Lecture Theatres, a Chemical Laboratory, a Dissecting-room, mortuary chambers, and students' halls. It is, in fact, one of the most commodious and best ordered Medical Schools in the Metropolis.

There is a long tunnelled way under ground, running to the chambers for the dead in this building, from the several Hospital blocks, from one part of which a branch passage leads to the wash-house and laundry. One of the mortuary rooms is to be arranged as a sort of Morgue, or reception room for friends who come to pay a last visit to the dead; and a pair of large gates opening upon the Lambeth Road will admit the hearse to this portion of the Hospital, when it comes to claim those portions of the remnants of vitality that have not found another mode of escape through the campanile tower. This "old mortality" end of the Hospital nestles curiously close under spiritual over-shadowing. It is only separated from the battlements of the Archbishop's palace at Lambeth by the stables and coach-house of the Treasurer of the Hospital.

The new Hospital of St. Thomas promises to be one of the most complete and efficient of the hospitals and medical schools of the metropolis. R. J. M.

## ZOOLOGICAL TEXT-BOOKS

*General Outline of the Organisation of the Animal Kingdom and Manual of Comparative Anatomy.* By Prof. Rymer Jones, F.R.S. (Van Voorst.) Fourth Edition. 1871.

*A Manual of Zoology for Students.* By Dr. Henry Alleyne Nicholson. (W. Blackwood and Sons) 1870.

THE mass of information which is continually and rapidly accumulating in every department of Natural Science, renders it increasingly desirable that every manual writer should zealously aim at combining terseness with accuracy, and, by a well-chosen selection of the most important facts, exhibit the results of the more recent acquisitions of science. In the ponderous volume of 886 pages, which now replaces the long-known "Comparative Anatomy" of Prof. Rymer Jones, the very opposite characters are painfully conspicuous, and we sincerely pity the student who has recourse to it for his instruction in zootomy. Not but what the book is both highly instructive and interesting, and exhibits conspicuously the learning, patience, and zeal of its accomplished author. For all this, however, the youth who gets up his zoology and comparative anatomy from it, will find himself out of joint with and wanting, as regards the zootomy of the present day, while he will have wasted time over comparatively useless and antiquated details.

The Rotifera are, indeed, strangely located, being described in one chapter with all the Crustacea except the Cirripeds, which latter are placed apart in a separate chapter. A still more important defect, however, and one almost incredible, is the complete omission of all reference to the Rhizocephala. After this it is not surprising that no notice is taken of those recent discoveries as to larval Ascidians, which seem to indicate a genetic affinity between them and the Vertebrata, and which are now made familiar to all by Mr. Darwin's "Descent of Man." This is the more remarkable, as at p. 666 the author speaks of the Amphioxus as in some respects resembling Ascidians, and being thus connected with the Mollusca. Another singular and conspicuous blot is the location of the Brachiopoda between the Lamellibranchiata and the Gasteropoda.

When we come to the great Vertebrate division of the animal kingdom, we are again painfully impressed by defects and shortcomings, which sometimes must lead to downright error on the part of the unlearned reader.

The Batrachians are lumped together with the true Reptiles in one class, and the student could hardly gather from Prof. Rymer Jones's pages that the true affinities of the former are with fishes, while the latter are closely related to birds. In the general index we read "Comparison between Birds and Reptiles, p. 760, sec. 2,032." We turn to the page and section indicated, expecting to find a succinct statement of the results arrived at by Profs. Huxley and Cope. In reality we find but a meagre statement of the obvious physiological contrasts between the two classes.

Owen's hypotheses as to the essential nature of the vertebrate endoskeleton and its several parts, are given without criticism or discrimination, as if they were views universally received and recognised. But there are positive errors which it is difficult to stigmatise too strongly. Thus, in spite of Prof. Huxley's papers, it is gravely asserted of the terminal caudal vertebræ of homocercal fishes, that they "are commonly blended together, and shortened by absorption, whilst both neural and hæmal arches remain with increased vertical extent, and indicate the number of the metamorphosed and obliterated centrums!"

Of Prof. Owen's hæmal cranial arches, it is said that his labours "have satisfactorily revealed their real nature, and established *beyond a doubt* (the italics are ours) the alliances which exist between the elaborate structures in question and the arches which exist under singular conditions appended to the vertebral segments of the trunk."

At the other end of the skeleton all the valuable re-

searches of Mr. Parker, Prof. Huxley, and antecedent Continental authors are ignored, and the essential affinity between the embryonic mammalian skull and its permanent condition in Batrachians and cartilaginous fishes is passed over in silence.

Similar incompleteness is to be found in treating of single organs in single classes. Thus, in speaking of the swimming bladder, its homology with the lung is only faintly alluded to in terms hardly of approval, and nothing is said of its interesting condition in Polypterus.

As to Birds, the inquirer who consults this manual only will fail to acquire any really adequate knowledge of the class, from the absence of all description of its two very distinct existing types—the struthious and the carinate birds. As regards the omission of any notice of the Archæopteryx, it may be pleaded that it is a fossil form; still a manual of zoology must be reckoned as singularly incomplete which fails to call attention to a form so importantly aberrant.

In the highest class of Vertebrates we miss any adequate statement of the very great gap which exists between the Monotremes and the higher Mammals.

Prof. Flower's careful labours regarding the corpus callosum are utterly ignored. Thus we read, "In those Marsupial tribes that form the connecting links between the oviparous and placental Vertebrata, the brain still exhibits a conformation nearly allied to that of the bird, and the great commissures required in the more perfect encephalon are even yet deficient; but in the simplest brain of a Placental Mammifer the characteristic differences are at once apparent." The student is left entirely in the dark as regards the large anterior commissure of the lower forms which compensates, as it were, for the reduction of the corpus callosum, while presenting such a contrast to the brains of birds and reptiles.

The facts here mentioned will enable the zootomically instructed reader to appreciate the defects which unhappily characterise this last production of Prof. Rymer Jones. As we have said, they do not prevent the volume being replete with both interest and instruction, and a large number of readers may study it with advantage, though it is not calculated for young students who wish to be *au courant* with the latest views and those received by the most esteemed biologists. The prevailing character of the book may be summed up by saying that we have in it almost a maximum of physiological anatomy with a minimum of morphology.

Turning to the much smaller work of Dr. Nicholson, we feel refreshed by coming in contact with a body of more modern views and less-known facts put forth concisely and in a form really useful to the student. There is a copious glossary, the utility of which will far more than compensate for some inaccuracies. There is also (what no book of the kind should lack) an alphabetical index, the want of which will be sadly felt by those who use Prof. Rymer Jones's volume. Nevertheless, Dr. Nicholson's manual, though serving as a stop-gap to supply an urgent need, is not, by any means, all that could be desired. Some of the very glaring omissions we have noticed in the large work are also defects in the smaller one. Thus we have again the absence of any reference to the Rhizocephala, but that larval Ascidian structure is noticed "which has been paralleled with the chorda dorsalis of Vertebrates."

The Brachiopoda are relegated to the vicinity of the Polyzoa, and removed from the Mollusca proper. The Batrachia are associated with the fishes, the Reptila with the Birds. Man is put back into the order Bimana, which appears to us a mistake when he is considered from the zoological point of view only. Investigations and discussions of recent date have abundantly demonstrated that in bodily structure he differs far less from the higher "so-called" Quadrumana than do these latter from the lowest members of that order. In connection with recent investigations it must be remarked that Dr. Nicholson does not sufficiently acknowledge how largely his work reposes on the labours and teachings of Prof. Huxley. That Professor's system and arrangements are almost entirely adopted, even to the location of the class Echinodermata in the subkingdom Annuloida.

It is much to be regretted that the last-named eminent naturalist has not ere this given to the world the results of his labours in his own clear and terse language, and published a model handbook for the use of students. In the absence of such a desideratum we feel sure that Dr. Nicholson's work will, for a time, be deservedly popular and widely used. More than this we cannot, however, anticipate for it without careful and copious additions and emendations.

## OUR BOOK SHELF

*A History of the Birds of Europe, including all the Species inhabiting the Western Palæarctic Region.* By R. B. Sharpe, F.L.S., &c., and H. E. Dresser, F.Z.S., &c. Part I. (London: published by the Authors.)

THIS work will supply a great want, since it will give in a convenient form and at a moderate price, a really good coloured figure with a full and accurate description and history of every European bird. The talent of Mr. Sharpe for publications of this nature has been sufficiently shown by his beautiful work on the kingfishers, which we have already noticed, while his colleague, Mr. Dresser, is an enthusiastic student of European birds. In M. Keulemans they have secured an artist who bids fair to rival Wolf in the delineation of bird character; and if the work maintains the standard of its first part (and we have every reason to believe it will do so), its subscribers will have cause to be satisfied. We find in the part now issued eight species of birds beautifully figured, and about forty-six pages of letterpress, crowded with information from every available source on the habits and distribution of the species. The series of charming pictures of the most graceful of all living things which this work will give, must render it a general favourite; and it will assuredly help to extend the growing taste for natural history, by rendering it comparatively easy for the traveller or resident on the Continent to determine the species and refer to an outline of what is known about any bird he may meet with during his rambles in the country or in the markets. To the home naturalist, also, it will prove far more interesting than a work on British birds alone; for he will here find how far over the globe his feathered friends are accustomed to range, and will make the acquaintance of many members of their several families who, although they live permanently abroad, yet retain a strong likeness to their English relations. We heartily wish Messrs. Sharpe and Dresser success in their bold and laborious undertaking.

A. R. W.

*A Treatise on the Action of Vis Inertiæ in the Ocean.* By W. Leighton Jerdan, F.R.G.S. (London: Longmans.)

THIS book is a lamentable instance of misconception and error. It is founded on a denial of the first law

of motion that a body, if moving, will continue to move in a straight line with uniform velocity, provided no forces act on it. There is through the whole book the most hopeless confusion as to what is meant by no forces acting. The author's theory of the cause of the moon's motion will illustrate the character of the book. It is briefly this :—If the moon were pulled only by the earth's gravitation, it must fall to the earth. It must therefore be pulled in the opposite direction with an exactly equal force. This is called by the author the force of astral gravitation. Since these two exactly balance one another, the question arises, What can cause the moon to revolve round the earth? "A cause," says the author, "for the onward motion of the moon according to the action of well-known laws, is, however, indicated by various well-known tidal phenomena. For the moon tends to raise a mass of water or tide on the earth's surface beneath it; and as the earth's surface rotates eastward, it tends to carry that mass of water or tide with it; and therefore as the moon tends to hold the tide beneath it, the rotation of the earth eastwards must just as certainly tend to carry the moon eastwards as to carry the tide eastwards." Really it is quite irritating that such nonsense should be printed in large type, on good paper, and in a well-bound book.

It is one of the great merits of error that it is inconsistent. That the author enjoys the full satisfaction of this merit is evident from the following :—"If the moon and earth were at rest, then astral gravitation would tend to carry the moon directly from the earth, not at a tangent to any part of its orbit; and when in motion, astral gravitation tends to carry the moon off at a tangent from its orbit certainly, but *in the opposite direction to that of its motion* at the moment of its being released from the grasp of the centripetal force." The italics are the author's—not ours. It appears from this that the author denies the second law of motion, as well as the first, which he elsewhere denies. He here assumes that the effect of a force on a body at rest can be at right angles to its effect on that body when in motion. It is much to be desired that those who undertake to write books would first learn the first principles of that which they write about.

*Catalogo Poliglotto delle Piante.* Compilato dalla Contessa di San Giorgio. 8vo., pp. i., 747. (Firenze, 1870.)

WE wish to call our readers' attention to this interesting little volume. Its authoress will be better known in the country as Lady Harly of Oxford; and she has spent many years in the compilation of this volume, which, we think, may prove useful to travellers on the Continent, and indeed, might even be made the means of instruction in our public schools. As an example, we select the *Bellis perennis*, which, a native of Europe, we find is, in English Daisy; French, Paquerette, *Marguerite vivace*, Fleur de Pâques; Italian, Pratolina, Margheritina de Prati; Spanish, Maya, la Margarita; German, Masslieben, Gänse Blümchen, Angerblume, Osterblümchen. But we find not only the European names of a large number of plants given, but, even in some instances, the Sanskrit, Bengal, Hind and Tamul names are also appended.

W.

## LETTERS TO THE EDITOR

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

### Variability and Natural Selection

I ASK your permission to address to your readers some observations in support of the argument which Mr. St. George Mivart has adduced in his work on "The Genesis of Species," that Mr. Darwin has attributed too exclusive an effect in the origination of new species to the influence of his law of Natural Selection.

1. There are two facts on which Mr. Darwin's theory reposes—the one the variability of animal and vegetable forms; the other, the accumulation of a useful variation by force of the struggle for existence, or Natural Selection. Mr. Darwin assumes Variability to be accidental, not because he or any other philosopher supposes that there is such a thing as accident, but because its law is unknown. He then finds the law of Natural Selection, and by this and this alone, explains the Genesis of Species.

Now, inasmuch as Natural Selection operates on Variability as a pre-existing fact, it follows that the genesis of a new species must result from the operation of two laws—namely, the law of Variability and the law of Natural Selection. But Mr. Darwin attributes it exclusively to the latter; so that, according to his view, there is a law (that of variability) which has no part in producing a result which yet depends for its existence on the fact regulated by that law—namely, variation. This is enormously improbable. It is as if the resultant from two factors were attributed exclusively to one of these factors.

The fact that Mr. Darwin assumes variation to be accidental is, of itself, sufficient to make us expect some residual phenomenon not accounted for by the law of selection: but Mr Darwin's argument does not allow the existence of such a residuum.

2. Mr. Mivart, following the *North British Review*, has shown the great advantage in the struggle for existence which the numerical superiority in individuals of the original form over the new variation may give to the original form. I want to call your attention to the fact, that the useful variety has to overcome not only this advantage to its antagonist resulting from numbers, but a quite distinct difficulty, namely, the tendency to reversion; or, that in other words, the force which Mr. Darwin has at his disposal is not the tendency to accumulate a variation, but only the balance of this tendency over the tendency to reversion.

It is no doubt difficult to estimate the extent to which one tendency is controlled by the other; but to gain some notion of it, let me assume the existence of three forms, with a male and female of each, viz.,

| male | female |
|---|---|
| $a$ | $a'$ the original form |
| $b$ | $b'$ the first variety |
| $c$ | $c'$ the second variety |

Let me further indicate the existence of an accumulated variation by the double letter $bb$, or $cc$. Let me then assume an equal chance of sexual intercourse between each of the six individuals and of progeny from such intercourse, and we shall see what are the chances of the origin of an accumulated form. For the union of

| | | | | |
|---|---|---|---|---|
| $a$ | and | $a'$ | produces | $a$ |
| $a$ | ,, | $b'$ | ,, | $a$ |
| $a$ | ,, | $c'$ | ,, | $a$ |
| $b$ | ,, | $a'$ | ,, | $a$ |
| $b$ | ,, | $b'$ | ,, | $bb$ |
| $b$ | ,, | $c'$ | ,, | $a$ |
| $c$ | ,, | $a'$ | ,, | $a$ |
| $c$ | ,, | $b'$ | ,, | $a$ |
| $c$ | ,, | $c'$ | ,, | $cc$ |

So that in the first generation the chance against any given accumulated variation being produced are 8 to 1, and the chances against any accumulated variety at all being produced are 7 to 1; and these odds will go on increasing, because the next generation will retain the tendency to revert to the original simple parent form $a$, not to the original forms of the last preceding generation only. If I assume that each marriage in the first generation produced two males and two females, the result will be, that in the second generation the chance against any given accumulated variety being produced will be 320 to 4 or 160 to 2; and the chance against any accumulated variety at all being produced will be 316 to 8 or 79 to 2.

These chances express the force of the tendency against which Natural Selection has to operate, assuming that the numbers of each variation at starting were equal to those of the original form; but this is, on the assumption that variation is accidental, infinitely removed from the truth; and if the difference between the numbers of the original form and the variation be introduced into the case, the odds are indefinitely increased against the accumulation of a casual variety. None of these observations goes to show that Natural Selection does not exist (I have

no doubt that it does), but they show that it has a most uphill game to play, and one in which it is improbable for it to win without help from some other principle.

It may be objected to what I have alleged that the result of the marriages between the individuals of the original form *a* and the varieties *b* and *c*, will not be of the pure original form, but forms half way between that original form and the variety. This will often be the case, but then the improper form of *a* will have in future generations an increasing tendency to revert to the pure original.

3. Mr. Mivart has adduced the co-existence of closely similar structures of diverse origin as evidence that there is a law of Variability over and above the principle of Natural Selection.

The argument appears to me worthy of great consideration. If variability be a force operating in every direction equally, it is very improbable that the course of any two variations should run parellel; if on the other hand the tendency to variation operates along particular lines, then it is likely that the lines which represent the course of separate varieties should run parallel. How do the facts stand? The placental and marsupial quadrupeds form two distinct groups which branched off from one another in very remote times, and yet the two groups have developed into classes and sub-groups so correspondent that their courses may best be described as two parallel zigzag lines. Such a fact almost necessarily involves the conception of one and the same force controlling each group, so as to make it pass along its respective course, just as the likeness of two oak trees implies a like inherent force in each acorn.

But this is not the only instance which Mr. Mivart adduces; he produces the fact that there are two parallel bridges which span the space between birds and reptiles; and I desire to add this further fact not noticed by Mr. Mivart, that there are in like manner two parallel bridges between fishes and reptiles. As is well known, there still exists a small class of animals, half fish and half reptile, often known as the Amphibia. They possess lungs like reptiles, but like fish they have gills and the consequent modification of the hyoidal arch, and their fore limbs have what may be called a degraded and fishlike form. The Archegosauri are extinct creatures of the carboniferous strata—like the existing Amphibia, half reptiles, half fish; like them they carried both gills and lungs, and like them they had the fore limbs in a degraded condition. So far there is nothing to the point; but to the foregoing must be added that the existing Amphibians are a bridge between reptiles and the hard-boned fishes, which are the predominant modern class; whereas the Archegosauri were a bridge between reptiles and the ganoid fishes, to which class they were related by the character of their teeth, the imperfect ossification of the internal skeleton, and the excess of ossification in the external skeleton (Owen's Palæontology, p. 193, *et seq.*). This observation will remain true, even if it should be shown, as some naturalists expect, that the Archegosauri were a tadpole form of a more perfect reptile; for it can hardly be doubted that the immature form expresses the history of the perfect one, and shows by its likeness to the ganoid fishes the original relation to that class.

It has often appeared to me, that there are striking parallelisms in the three great groups of the Quadrumana. For instance, the vocal organs of the Hylobates or Gibbons of the Indian Archipelago present a close relationship to those of the Mycetes or Howlers of the South American forests. The nocturnal and insectivorous habits of some of the American genera recall the like habits of most of the Lemurs: and again, the Baboons are related to the Anthropoid Apes in a way which suggests to the mind that the similarity of their forms is greater than the nearness of their kinship.

There is no doubt that similar parallelisms may be observed in very many groups; and I think that many of those phenomena of likeness which Mr. Darwin would attribute to atavism may as well be explained by the retention in each group of the force which was inherent in the original family from which both groups have proceeded.

This sort of parallelism is well illustrated by a very common accident: a tire gets loose from a wheel; but both it and the wheel pursue nearly parallel courses, except so far as they are operated upon by different external forces.

EDWARD FRY

## Protective Resemblances

HAVING read the various papers by Messrs. Bennett, Murray, Wallace, &c., in NATURE, and thinking that my observations made on plants and animals in various parts of Southern Africa may be of some interest to your readers, I am rather hastily putting together a few facts, which it had been my intention to have worked up into an illustrated paper, but which may perhaps prove of most interest at present, while the discussion is still warm.

I must own that I prefer the use of the general term "protective resemblance" to the special term "mimicry," as the latter seems to imply a certain amount of *intelligent volition*, which in the instances cited by Messrs. Wallace, Bates, and Trimen, I believe does not apply, whereas there are, I believe, cases where instinct does come into play, not acting physiologically as Mr. Bennett would seem to assert, but in the construction of disguises.

Mr. Bennett's argument appears to me as fully adverse to his own theory as to Mr. Bates's, and if Mr. Murray's theory is correct then it ought equally to apply to animals so widely different as ants and spiders.

Protective resemblances appear to me to be capable of being roughly classed as general and special, though both run into each other. Of general resemblances there are so many that I hardly think it worth while to enumerate instances, I shall therefore confine myself to some examples of special protective resemblances which I have noted.

1. As to plants I believe protective or useful resemblances are far commoner than some writers seem to think.

That excellent observer Dr. Burchell, in his "Travels," vol. i., p. 10, remarks:—"On picking up from the stony ground what was supposed a curiously shaped pebble, it proved to be a plant, and an additional new species to the tribe of Mesembryanthemum, but in colour and appearance bore the closest resemblance to the stones between which it was growing. On the same ground was found a species of the Gryllus tribe amongst the stones, and so exactly like them in colour and *even in shape* that it could never have been discovered had it not been observed just at a moment when in motion, and as if more completely to elude notice it seldom stirred, and even then but slowly.

"The intention of nature in these instances seems to have been the same as when she gave to the chameleon the power of accommodating its colour in a certain degree to that of the object nearest it in order to compensate for the deficiency of its locomotive powers. By their form and colour, this insect may pass unobserved by those birds, which otherwise would soon extirpate a species so little able to elude its pursuers, and this juicy little Mesembryanthenum may generally escape the notice of cattle and wild animals."

I may here remark that a great number of Karoo plants have tuberous roots of similar form and colour, and it is especially curious to notice that, amongst the Asclepiadeæ, many species, such as *Raphionueme*, which are found in the grassy country, have their tubers hidden beneath the soil, whilst others, which occur in the stony Karoo, such as, *Brachystelma filiforme*, have them above the soil, and so perfectly do they resemble the stones amongst which they are found, that, when not in leaf, it is almost impossible to distinguish them.

Of imitating plants I may mention *Ajuga ophrydis*, the only species of the genus in South Africa, which bears a striking resemblance to an orchid, as also does *Impatiens capensis*, another solitary species. I mention these especially because they are very striking, although I am not aware that they are in any way specially useful, noting, however, that the latter plant is much frequented by insects, often by similar species to those which frequent *Angræcum* and *Mystacidium*, plants affecting similar localities.

I know of many similar resemblances between plants belonging to most different orders, but cannot say how far they are merely fortuitous, and I am anxious to avoid Mr. Bennett's reproach of being "ultra-Darwinian."

With respect to the orthopterous insect mentioned by Burchell, that excellent observer, Mrs. Barber of Highlands near Grahamstown, communicated a most interesting paper to the Albany Natural History Society on a "Stone Grasshopper," which varies according to the nature of the soil of the district it inhabits; and I have in my collection numerous species of Locustidæ collected in the Karoo, whose successful imitation to the soil is most remarkable. I may remark here, that many most singular species of insects lose half their interest when penned down in a collector's cabinet.

As mimicry amongst mammals and reptiles is noted as rare, I may mention instances of what appear to me to be cases.

The plains of S. Africa are characterised by numerous animals generally known to the Boers as "Mierkatjes" (not little monkeys as Burchell renders it, but literally "ant cats"). Most of these are Viverrine Herpestes, Suricates, &c., and all have nearly similar habits. Early in the morning these pretty animals may be seen in numerous groups sitting up on their hind legs warming themselves in the sun, and, when startled, scampering away to their holes, with their tails cocked high up in the air. They are likewise more or less coloured like the Karoo soil, although when individually examined their colours, of course, differ.

All these feed on mice, small reptiles, and grasshoppers and locusts. They likewise greedily devour birds' eggs. Equally common with these in some parts, but especially noticed by me near Cradock, is the *Xerus setosus* Gray, or ground squirrel. It is likewise known as a Mierkatje by the Boers. Unlike the other Mierkatjes it feeds on small bulbs and tubers called "limtjes" by the Boers. Its colour, habits, and long tail, cocked up in the air, gives it a striking resemblance to its Viverrine neighbours; while in common with them it forms burrows in the ground. Of reptiles there is a species of *Dasypeltis*, a snake almost devoid of teeth, very common about Algoa Bay, but with whose specific name I am not acquainted. When irritated this species coils itself up and darts angrily at the intruder, puffing and hissing loudly. When I first met with it I was rather cautious in handling it; but discovering its harmlessness I have kept several in confinement.

A few years ago I was examining some Bushman caves in the Nuncazana Valley, Bedford District, when my Hottentot servant told me that there was a "Groste Nacht-adder" in the cave, and I found what I also took to be a large Night adder. It sprang at us, and nearly escaped. On examining it when dead I was much surprised to find it was a very fine specimen of my old friend the *Dasypeltis*, as I had not met with the species since I had left Port Elizabeth. Night adders are common in the Nuncazana, as also here. On comparing the two snakes I was much struck by their general resemblance, although, of course, the *Dasypeltis* has a very dissimilar head; but the curious way it has of blowing itself out, and distending its neck, and darting at intruders, heightened the resemblance. I cannot help thinking that these habits must be serviceable to so harmless a snake.

In general protective resemblance Reptiles and Batrachians offer countless examples, and it is especially noticeable amongst the *Agamidæ*, one species of which varies throughout the eastern part of the colony and Free State.

With respect to butterflies I need not enlarge, Mr. Trimen having done his work most thoroughly. I may mention, generally, that *Philognoma varanes*, when its wings are closed, strikingly resembles a dead leaf, and two of its varieties, ♂ and ♀ *P. Agathina*, are found in forests, and their flight strongly resembles falling leaves, as does also that of *P. poppea*. In his work on the "Rhopalocera" he mentions the resemblance between the larva of *Diadema bolina* and *Danais chrysippus*. Amongst birds which I have noticed capturing Lepidoptera I may mention that I have seen *Tchitrea cristata* darting at *P. Agathina*; *Cypselus caffer* I have seen take small moths from the grass, and dart at *Terias Rahel* on our open flats; *Motacilla capensis* I have seen take moths and *P. hellica*; *Dicrurus musicus* is a voracious bird amongst insects, and takes moths, though I cannot state I have seen it capture Rhopalocera, yet I think it also attacks *Pieridæ*.

*Mantidæ* and some species of flies are, together with spiders, I believe, the greatest persecutors of Rhopalocera. One large kind of fly pursues *Satyridæ* and *Tulbaghia meneris*. I have found a Phasma in the crop of *Strix affinis*.

The most perfect cases of mimicry I know of are two spiders (specific nature unknown to me) which bear the closest resemblance to ants. They belong to the *Salticidæ*, and are, apparently, related to *Salticus formicarius*. The one is smooth, black, and shining, and runs rapidly on the ground and bark of trees, and resembles the ant which builds its nest in *Acacia horrida*, and is used by the Kafirs for the purposes of torture. The other is larger and has its cephalothorax dull black, and its abdomen covered with short yellowish hairs. It is generally found running on the stems of herbaceous plants and small bushes, and closely resembles an ant found in similar situations. The fore legs in both species are larger than the second pair, and are frequently held up, when they closely resemble the antennæ of ants. So exceedingly close is the resemblance that, at first sight, I have almost always taken them for the imitated ants.

The most singular cases of protective resemblances in other orders are those of *Pephricus paradoxus* Sparr.; particularly remarked on in that traveller's work on South Africa; of another Heteropter in my possession apparently allied to the genus *Phlœa*, and which I discovered by the greatest fluke, so closely did it resemble a knot of the twig on which it was; of two species of Phasma, one believed by Mr. Trimen to be *Palophus Haworthii*, Gray, both of which were found in the Karoo on dead branches. *Acacia horrida*, known as the "Doorn Boom," or Mimosa throughout the Eastern province, is a perfect museum of protective resemblances.

I have the larva of a moth, which forms a case so exactly like the thorns of that tree that no one could detect it when not in motion; Mr. Trimen will, I hope, determine the species. A caterpillar belonging to a geometric moth, which piles the blossoms on its back, and doubles itself up so as exactly to resemble the flower heads; a larva of a species of *Neœra*, which exactly resembles the young thorn leaves on which it feeds, and which forms a pupa in a case resembling an excrescence of the bark; an Epeira which has two excrescences on its abdomen exactly resembling two old broken thorns. I could recount a number of other similar instances, but for the fear of trespassing too much on your space.

Lastly, I would remark how long it often is before frugivorous birds discover fruit not indigenous to the country.

In the drought of 1865 I was much struck by this. We had a solitary damson tree, which had not previously borne much fruit, but which that year had abundance. The mousebirds (*Coleus*) and the Red-wing (*Inida morio*) had devoured the almond and peach blossoms and the figs. With two double-barrelled guns we could not keep them from the latter. Meanwhile the damson tree was never touched, but ripened its fruit beautifully. On the morning of Christmas Day my friend intended taking them to his sister-in-law. Two hours later there was not a damson on the tree; the birds had just found them out, and had strewn the ground with their stones.

Now it has struck me that slight variations in insects may be of much greater value than one might at first sight imagine, and such would Mr. Weir's experiments lead one to expect, the birds selecting certain kinds of dull coloured larvæ from amongst others.

The beautiful instances afforded by the plants and insects I have enumerated can surely be only interpreted by Natural Selection. There can be no hybridism nor instinctive accumulation of resemblances in plants or between plants, grasshoppers and stones, and why should we go out of the way to call in a theory or theories, for which there are no facts as supporters, when we have at hand an explanation so much simpler, and which readily embraces every case?

I have myself no doubt that instinct may come into play, as in the case of the thorn imitator, &c.; and I believe something of the kind is noticeable in savage man, in the disguises he uses. It is a well-known fact that our soldiers often fired at aloes in the Fish River bush, mistaking them for Kafirs, as their red paint is an excellent disguise in the Bush. The North American Indian and the Bushmen adopted numerous disguises in hunting their prey, or in tracking their enemy, and no one who has not seen the latter can appreciate his wonderful power of imitating all kinds of animals.

In conclusion, I may remark that whilst many species of Rhopalocera are most abundant in S. Africa, it is very rarely that one finds their larvæ or pupæ. I have been astonished at the small success I have had in cases where the imagines are most abundant.

J. P. MANSEL WEALE

Brooklyn, near King William's Town, Kaffraria

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## Sexual Selection

MR. DARWIN in his recent work on the "Descent of Man" has shown that throughout the animal kingdom the male generally displays the stronger passions and is always the most eager. The males, moreover, whenever secondary sexual characters occur, are, as a rule, the possessors of weapons for defence or offence, brilliant colours, or other ornamental appendages, all of which Mr. Darwin supposes to have been acquired through sexual selection, either for the purpose of charming the female or for struggling with other males for the possession of the females. In a few exceptional cases among birds, the females are the wooers, and these are then more brilliantly coloured than the males. In Westwood's work on insects* I met with the following passage:—"M. Donzel has published a curious memoir upon

* "An Introduction to the Modern Classification of Insects." Vol. ii. p. 336.

the flight of butterflies whilst coupling (Ann. Soc. Ent. de France, 1837, p. 77.) showing that whilst the males of *Pontia Brassicæ*, &c., *Colias*, and *Polyommatus* support the females, it is the latter which support their partners in the genera *Thais*, *Thecla*, *Argynnis*, *Melitæa*, *Hipparchia*, and *Pieris*." Now this is strictly analogous to these exceptional birds, because, among our British representatives of these genera whenever a considerable sexual difference of colour occurs, *the female is always the more brilliantly coloured*. Thus, the female *Thecla Quercus* has the bright purple patch, and the female *Thecla Betulæ* the brilliant orange blotch on the fore wing, while the females of *Hipparchia* (*Satyrus*), *Janira*, and *H. Semele* are considerably brighter than their partners. The female *H. Megæra* is rather brighter than the male, and the same is true of *Colias Edusa* and *C. Hyale*, since the females of these species have orange or yellow spots in the black marginal border, represented in the males by thin streaks only. The females of the whole genus *Pieris* also are ornamented with black spots on the fore wings, which are only partially present in the males. I must confess that I am not convinced of the action of sexual selection in producing the colours of insects, but it cannot be denied that these facts are strikingly corroborative of Mr. Darwin's views. With few exceptions the rule holds good throughout the exotic species of these genera.

R. MELDOLA

## The Irish Fern in Cornwall

OWING to an accident I did not see NATURE for the 23rd of February till yesterday. In a note which appears in it, on the report of the Cheltenham College Natural History Society, a doubt is expressed as to the accuracy of the statement that the fern, *Trichomanes radicans*, has been found in Cornwall. Knowing that it had not yet been recorded from that county, I have, for some years past, intended to take an early opportunity to make the following facts public ; time has, however slipped away, and I have never yet done it.

In August of the year 1867, at St. Knighton's Kieve, a romantic ravine and waterfall on the northern coast of Cornwall, about two miles from Tintagel Castle, I obtained an undoubted specimen of this fern. It grew on a rock overhanging the water, about a quarter of a mile below the fall. It was an exceedingly small patch, and I accordingly contented myself with a small root bearing two fronds. Wishing to grow this specimen instead of drying it, and having unfortunately placed it in a hot-house, the plant died. I have, however, preserved it, withered and dried up as it is, and when I return to London, where my herbarium is, I shall be glad to produce it for the satisfaction of any sceptics. In the following year (1868) I paid an exceedingly hurried visit to the same spot, but failed to find the fern ; never having been in the neighbourhood since, I have been unable to confirm or to dispel my fear that the plant has been discovered by some ruthless collector. I may add that I have long since mentioned this fact to various friends interested in Botany.

Morebattle, Kelso, April 6 EVERARD F. IM THURN

## Fertilisaton of Hazel

IN a recent number of NATURE Mr. Bennett makes some remarks on the above. What he says leads to the belief that the male flowers of any one plant discharge their pollen just at the very time the stigmas of the female flowers of the same plant are receptive. My observations made this spring, and extending over a number of specimens, quite agree with those of Mr. Marcus Hartog, and therefore break through Mr. Bennett's law, and show that although the hazel is apparently monœcious, yet, practically, it is dicœcious. On one plant which I pointed out to several gentlemen, the fertile flowers had their pretty red styles protruded beyond the scales and the receptive stigmas long before a grain of pollen was discharged from the adjoining catkins, whilst on another plant a hundred yards distant from the first all the barren flowers were withered up and ready to fall before the females could be seen.

Lexington, Kentucky JOHN DUNCAN

## Thunderstorm at Preston

ON the 25th of last month a violent thunderstorm occurred at Preston, in Lancashire. The spire of St. Walburge's Church, which is, perhaps, the highest point in the town, was struck by lightning, some curious phenomena resulting. The lightning conductor, a rope composed of forty-two copper wires in six strands, was ruptured at about sixty feet from the ground. The wires were untwisted and spread out, the ends fused, and some of them turned up like hooks. The discharge passed obliquely through the tower wall for a distance of about three yards to a gas-pipe inside. In its passage it wrenched a piece of stone weighing 66lb. from an immense block, casting it to a distance of a hundred feet, besides literally tearing off other large masses. Before reaching the gas-pipe it projected some bricks against the opposite interior wall, shattering them to pieces. The gaspipe was severed and the lower portion curled completely round. Thence it passed to the gas-meter and dislocated many pipes beyond. The effect upon one leaden pipe was singular, holes were fused into it, in some cases right through, the molten metal being scattered about. Another discharge passed down a conductor at the west end of the church. The conductor itself was not ruptured, but a gas-pipe close to it was broken and a piece about a yard long was projected to a distance of forty feet, the gas meanwhile having ignited. Within the church, too, where there happened to be a leakage, the gas also ignited. It was further observed next morning that round about the church hundreds upon hundreds of worms were dead or dying.

Stonyhurst College STEPHEN WILLIAMS

## Meteorology in Asia

IN NATURE, vol. iii. p. 473, it is said, "from Asia Minor we get no scientific records of weather." Perhaps you will pardon my informing your readers that the Turkish Government has eight telegraphic meteorological stations, besides its Central Observatory at Constantinople, under M. Aristide Coumbary. The stations are Sulina, Varna, Salonika, Fao, Bagdad, Smyrna, and Beyrout.

Two of these are in Asia Minor, and Beyrout is not far off. The observations are published monthly. In addition Mr. E. Purser, C.E., of the Smyrna and Aidin Railway Company, has published his observations for several years.

ROBERT H. SCOTT

## A Wind Direction Rain Gauge

REFERRING to the paragraph in your number of March 30, p. 433, and Mr. Lyall's letter, April 6, p. 488, on Mr. Napier's "Wind Direction Rain Gauge," I beg to say that a gauge of a similar construction is in use at the Meteorological Observatory, Army Medical Department, Aldershot Camp. It was devised by the observer, Mr. John Arnold, A.H.C., F.M.S., about three years ago, so it would appear that the credit of the invention, if I may so term it, is due to no less than three parties, to each of whom I believe the matter was entirely original.

JOHN JAMES HALL, F.M.S.

Meteorological Observatory, Fulwell, near Twickenham, April 20

## Spectra of Aurora, Corona, and Zodiacal Light

WHILE I am glad on my part to see Mr. Henry R. Procter's letter on the spectra of terrestrial aurora and solar corona in NATURE, p. 468, he may not be displeased on his to receive a confirmatory statement from an independent observer ; and to this effect, viz., that whereas, firstly, the spectra of nineteen out of twenty auroras this winter have practically shown me nothing but one bright green line, and secondly, the spectrum of the solar corona, as seen during total eclipses, is said to be mainly characterised also by a similarly single vivid green line, yet it is not the same green line in the two cases, but a something widely, absolutely, physically, different.

I shall be glad, however, to be allowed still further on a branch of this subject, to ask, through the medium of NATURE's useful columns, whether anyone can kindly supply me with recent observations of the spectrum of the zodiacal light?

I have been trying for it in vain all this spring-time, and have now in despair given it up for the season. M. Angström—to whom be all honour for his first observation and correct description of the ordinary auroral spectrum—says that the zodiacal light spectrum shows the same green line as the aurora, viz., 1249 (Kirchhoff) ; but the eclipse observers, after proving that

the corona is cosmical, solar, and the denser part of the zodiacal light,* might expect the latter rather to show the corona's green line, viz., 1474 (Kirchhoff).

This, however, the zodiacal light, according to M. Angström, does not. Is the zodiacal light then telluric and auroral, not solar and coronal? The measurement of the *place* of its green line should settle at once this most important and extensive physical question; and if the line be at any time visible at all, the large spectral distance between 1249 and 1474 (Kirchhoff's scale) would be sensible in the simplest apparatus. Yet, in these high latitudes the zodiacal light is always so extremely faint, so frequently altogether masked by auroral glows, and as yet, for its spectrum, depending, so far as I know, on only one observer, and he residing in quite an aurora-ridden part of the world, that it would seem to be a perfectly fair question to ask, "if any one else, besides the distinguished Natural Philosopher at Upsala, has observed the spectrum of the zodiacal light; and if so, how and where?"

C. PIAZZI SMYTH

Royal Terrace, Edinburgh, April 14

* [We venture to doubt this.—ED.]

## Aurora by Daylight

I SEE that more than one of your correspondents in December numbers dispute the possibility of an aurora being seen by daylight. It doubtless is a rare occurrence, but two cases of the kind have come under my notice.

In December last my son saw what he took to be an aurora a little before sunset. He was at the time about three miles from home, and he had it constantly before him during his walk homewards, and saw it more and more developed as the darkness increased, so that there can be no doubt of the appearance before sunset being identical with what proved to be, as the night advanced, one of the most brilliant displays which we have had during a year very prolific in auroras. He states that after the sun had set, but whilst it was still quite light, the bright rose colour which distinguished that aurora was distinctly visible. The streamers that night proceeded from all parts of the heavens, meeting almost in the zenith, but what is very unusual, they were very much brighter in the east and south-east than in any other direction, which is probably the reason why they were so clearly visible whilst the sun was in the opposite quarter.

The other case came under my own observation in September 1849. Immediately after the sun had set, with a perfectly clear sky, I noticed three slightly diverging beams of light on the western horizon. One might almost have taken them for those beams from a setting sun which one sees much more often in pictures than in nature, had it not been that they did not emanate exactly from the spot where the sun had set, that they had an evident motion to the southward, and that two of them extended to the zenith, and finally down to the eastern horizon. It proved to be the most symmetrical auroral arch I ever saw. The perfect horizon I had to the west, and the straightness of its well-defined edges, joined to the facility which the double arch afforded of measuring the distance between the middle of each, immediately struck me as affording an opportunity of calculating its elevation above the earth, upon the supposition that the tapering away towards the horizon was the effect of perspective alone. I took steps therefore to measure the apparent width in the horizon and overhead, and also its rate of motion to the southward in both places, and by both methods the result was about 8 to 1. From these data, upon the assumption that it was a double ring everywhere equidistant from the earth's surface, and moving parallel to itself, I calculated the elevation, which came out 97 miles, and its rate of motion to the southward 656 miles per hour, the auroral meridian being N. 13° 15′ E., and the inclination of the plane of the arch to my horizon 94° 55′. These figures, whatever reliance can be placed on them, have nothing to do with the present question further than to show how bright the object must have been thus to attract my attention, and that, although the sun had set, there was still daylight enough for me to see the second hand of my watch, and to note the objects on an horizon some three or four miles distant, by which I measured the progress of the base of the arch, and the bearings of which I took the next day. Before it became really dark, the arch had become irregular, and detached streamers showed themselves in the usual form.

Ottawa JOHN LANGTON

## UNIVERSITY INTELLIGENCE

### OXFORD

QUEEN'S COLLEGE.—Mr. Charles Thomas Blanchard of Clifton College, was elected to a Scholarship in Natural Science in this College on Saturday last. *Proxime accessit*—Mr. William Percy Ashe, of Magdalene College School.

CORPUS CHRISTI COLLEGE.—There will be an Election to a Natural Science Fellowship in this College at the beginning of next Michaelmas Term. The examination will be specially in Chemistry, and will commence on Monday, Oct. 9 Candidates must have passed all the examinations required by the University for the degree of B A., and must not be in possession of any benefice or property which would disqualify for retaining a Fellowship. Candidates are requested to communicate with the President, either personally or by letter, at their convenience, before the end of Act Term.

*Natural Science Lectures*

The following Lectures will be given in addition to those noticed in our number for last week:—

Chemistry. Mr. Wyndham on the Elements of the Nitrogen, Boron, and Carbon groups, and their Combinations, on Thursdays and Saturdays at 11 A.M., at the University Museum.

Physiology. On General Physiology, with special reference to the microscopical anatomy and physiological chemistry of the elementary tissues. By Mr. Chapman. Mondays, Wednesdays, and Fridays, at 10 A.M, at the Magdalen College Laboratory.

Physics. On Elementary Mechanics and Hydrostatics. By Mr. Abbay. These lectures are free by mutual arrangement to members of these colleges at which either of these gentlemen is a lecturer, viz, to members of Merton, Magdalen, Jesus, and Wadham Colleges.

### CAMBRIDGE

The following lectures in Natural Sciences are to be delivered at Trinity, St. John's, and Sidney Sussex Colleges during Easter term, 1871:—

On Heat. (For the Natural Sciences Tripos.) By Mr. Trotter, Trinity College, Monday, Wednesday, Friday, at 10, commencing Friday, April 28.

On Electricity and Heat. (For the Special Examination of the B.A. Degree.) By Mr. Trotter, Trinity College, Tuesday, Thursday, Saturday, at 10, commencing Tuesday, April 25. Students of Colleges other than Trinity, St. John's and Sidney, can be admitted on payment of a fee.

On Chemistry. By Mr. Main, St. John's College. Tuesday, Thursday, Saturday, at 12, commencing Thursday, April 27. Attendance on these lectures is recognised by the University for the certificate required by medical students previous to admission for the first examination for the Degree of M.B.

Instruction in Practical Chemistry will also be given.

On Geology. By Mr. Bonney, St. John's College.

1. Palæontology. Wednesdays and Fridays, at 9, commencing Friday, April 28.

2. Lyell's Principles of Geology. Tuesdays and Thursdays, at 9, commencing Thursday, April 27.

3. Elementary Lectures. Tuesdays and Thursdays, at 11, commencing Thursday, April 27. Students of other Colleges can be admitted to these lectures on payment of a fee.

On Botany (chiefly systematic and physiological.) By Mr. J. W. Hicks, Sidney College. Tuesday, Friday, Saturday, at 12, beginning Friday, April 28.

On Physiology. The Trinity Prælector in Physiology (Dr. M. Foster) will probably give a short course on Embryology at the New Museums, of which notice will be given.

The Physiological Laboratory will be open for practical instruction in Physiology daily. The lectures will be free to all Members of the University.

An election of a Superintendent of the Museums of Zoology and Comparative Anatomy was held on Tuesday, April 25, at one o'clock in the afternoon. This office was instituted in 1866, and was made tenable for five years; it is in the gift of the members of the electoral roll. The late superintendent, Mr. John Willis Clark, M.A. of Trinity College, was re-elected.

The Syndicate appointed November 17, 1870, "to consider whether any, and if so what, alterations may be made with advantage in the system of University examinations to enable persons who are unacquainted with the Greek language to obtain degrees," have issued an amended report. They recommend the substitution of French and German in place of Greek in the previous examination, at the option of the candidates. Every candidate who selects French and German will have to satisfy the examiners in papers containing passages from French and German authors for translation into English, with plain grammatical questions, and translate passages from English authors into French or German. In addition they will have to answer such questions on the Gospel selected for the Greek Testament subject and on matters collateral thereto as do not require a knowledge of the Greek language. The proposed alteration will come into force at the previous examination in the Lent Term, 1872. It will only affect those persons who proceed to a degree in honours; as a Greek classic the Acts of the Apostles in the original Greek are still retained as subjects in the general examination required of all candidates for the poll degree. A Grace, confirming the report of the Syndicate, will be offered to the Senate to-day.

The Board of Natural Science Studies have issued an amended report, recommending certain alterations in the examination for the Natural Sciences Tripos. They propose to separate the examination into two parts, and to continue it during eight days instead of six as heretofore. They also introduce a *viva voce* examination in addition to that by printed papers. The subjects of examination will be:—1, Chemistry and certain other branches of Physics; 2, Botany, including Vegetable Anatomy and Physiology; 3, Geology and Palæontology; 4, Mineralogy; 5, Comparative Anatomy, Physiology, and Zoology. The questions, exclusive of those which relate to practical work, will be comprised in twelve papers, and be so distributed that each of the papers will contain one or more questions in each of the following branches of science:—1, Chemistry and certain other branches of Physics; 2, Botany, including Vegetable Anatomy and Physiology; 3, Geology and Palæontology; 4, Mineralogy; 5, Comparative Anatomy, Physiology, and Zoology. Some of the questions will refer to objects exhibited at the examination. In the first six papers the questions will be of a more elementary character, and it will be open to the Board of Natural Sciences in any schedules which they may issue to indicate the subjects that shall be suitable for this part of the examination. In the last six papers the questions will take a wider range, yet still, so far as regards those branches for which schedules are issued by the Board of Natural Science Studies, will be confined to subjects indicated in the schedule; each of the last six papers will include a larger number of questions on the several subjects than the first six papers severally contain, and some of the questions will have special reference to the philosophy and history of those subjects. The Board further recommend that the foregoing alterations come into operation at the examination to be held in December, 1872.

### EDINBURGH

The half-yearly meeting of the General Council of the University of Edinburgh was held on Tuesday, the Chancellor presiding. A report was given in with reference to the graduation in Arts, and, after some discussion, it was agreed by a majority to represent to the University Court that the degree of M.A. should be remodelled. The report of the committee recommending the establishment of a Chair of Celtic languages and literature was approved. A report was given in proposing that two additional members should be appointed to the Curatorial Court by the University Council. The report was adopted. It was resolved by a majority that the Council should represent to the University Court that it was advisable that the regulations with reference to degrees in law at present in force should be amended to the effect (1) of having two degrees in law attainable by examination, and (2) of not requiring for the lower degree a degree in Arts as a necessary preliminary. Some other business was transacted, after which the meeting separated.

## *NOTES*

A PARAGRAPH has appeared in several papers stating that the venerable Professor of Geology in the University of Cambridge Prof. Sedgwick, purposed shortly vacating the chair. This announcement, we are credibly informed, is, to say the least, premature; and appears to have originated in a paragraph in the Professor's report to the University on the Museum under his charge. The words of this, however, do not necessarily imply more than that he begins to feel the burden of years heavy upon him; and in the University it is not believed that his resignation is imminent. Whether that come soon or late, all who have known how much he has done for the cause of natural science in the University will deeply regret it; and the fine collections in the Woodwardian Museum, amassed in great part during his tenure of the chair, and to no inconsiderable extent at his own expense, will long be a monument not unworthy of a life spent in the pursuit of science and in the service of his University.

THE subject for the Sedgwick prize, to be awarded in 1874, is "The Potton and Wicken phosphatic deposits and their general relation to the strata of Western Europe lying between the Portland beds and the Gault." The prize is open to all graduates who have resided sixty days during the twelve months preceding October 1, 1873. The essays are to be sent to the Registrary on or before October 1, 1873, privately with some motto prefixed, and to be accompanied by a sealed envelope with the same motto on the outside, enclosing a paper containing the name and college of the candidate. The prize was founded in 1865, by some friends of Dr. Adam Sedgwick, to encourage the study of geology. It consists of three years' interest on 500*l.* Scinde Railway Stock, but although subjects were proposed in 1867 and 1870, no essays were sent in.

THE Science and Art Department has issued a circular on the subject of the examinations in Ireland, which are henceforth to be placed on the same footing as those in England.

IN answer to several inquiries from America, we have great pleasure in stating that the report that the eminent astronomer, Leverrier, is reduced to great poverty, is entirely without foundation.

WE regret to record the death of William Wilson, the eminent bryologist, which took place at Warrington on the 3rd of April, in the 71st year of his age. Mr. Wilson is chiefly known as the author of "Bryologia Britannica," the standard work upon British mosses, which was published in 1855, and of which a second edition was in contemplation at the time of his decease. He took a high place as an authority upon mosses among continental botanists, and was in intimate communication with them. In the earlier portion of his life he devoted much attention to

British plants generally, and scattered papers in his name, often containing valuable observations in structure, may be found in the "Phytologist," and other botanical journals. He is frequently quoted by Sir W. J. Hooker, in the "British Flora," and contributed many specimens, accompanied by careful MS. notes, to the Hookerian Herbarium.

WE have received "Zur Erinnerung an Wilhelm Haidinger, von Franz Ritter v. Hauer," an eloquent tribute to the memory of the great mineralogist.

THE photographic papers record the death, at the early age of forty-seven, of Mr. T. R. Williams, one of the earliest photographic portraitists, and occupying the undisputed position of the most successful artist in his particular line. He was a pupil of Claudet's.

IN the first number of the "Zeitschrift für Ethnologie" of this year, is a very valuable list of works bearing on Mr. Darwin's theories, compiled by Spengel, which occupies twelve closely-printed octavo pages. First comes a list of translations into German of "The Origin of Species," of "Fertilisation of Orchids," and of "Variation of Animals and Plants;" next, forty-three original German works, criticising and carrying out the Darwinian theory. These are followed by about an equal number of books which refer to the same subject incidentally, though sometimes at considerable length. Among these we find Kupffer's "Essay on the Relation of Vertebrata to Ascidians," Von Baer's lectures, Carus's "Natur und Idee," and Rütimeyer's "Herkunft unserer Thierwelt." The fourth list is a most valuable one of reviews, magazine articles, and other scattered papers published in Germany on Natural Selection and the Descent of Man. Books devoted to the latter subject are next enumerated separately; and then translations into German of the kindred writings of Huxley, Lyell, Wallace, Agassiz, and Bates. Last comes a classified catalogue of all the works on Darwinism which have been published outside Germany, in England, France, Holland, and Italy. This list may be advantageously compared with that given by Mr. Darwin himself, in the 5th edition of the "Origin of Species." It will be invaluable to every student of the theory of evolution, and is a remarkable proof of the amount of scientific thought and work (as well as of some that is not scientific) which our great naturalist's writings have called forth.

A COMMUNICATION to the German Society of Anthropology during the past winter invokes the attention of all persons interested in science to the importance of making use of the opportunities for ethnological research furnished by the war between France and Germany; and the author, while acknowledging the difficulty of attending to such matters during the military operations, expresses his earnest hope that every possible effort may be made to secure a good series of the skulls and brains of the African tribes brought by France into the conflict, and especially those of the Turcos. We have not yet heard to what extent this suggestion was heeded by those who had the opportunity.

AT the last meeting of the Scientific Committee of the Horticultural Society, Mr. Alfred Smee introduced to the notice of the committee a new principle of boiler construction for heating hothouses, &c. The peculiarity consisted in the use of only one pipe for the flow and return of the water, instead of two, as is usually the case. Mr. Smee finds that the difference in specific gravity between the hot and the cold water is quite sufficient to keep the two currents perfectly distinct, and to maintain for any length of time a free circulation at a uniform temperature. The principle is, of course, precisely the same as that of the polar and equatorial ocean currents, with respect to which so much has been said in our columns.

UNDER the title of the South London Microscopical and Natural History Club, a society has been formed to enable microscopists and lovers of natural history residing in the district to meet and interchange communications and specimens; by lectures and papers to afford instruction to the younger members in the use of the microscope, and preparation of objects, and to develop a taste for the study of zoology and botany; and by occasional excursions into the country around to investigate the natural productions of the district and procure fresh materials for observation, which eventually may lead to the formation of a cabinet and herbarium, illustrative of the indigenous fauna and flora of East Surrey. The first meeting was held on April 1, at Gloucester Hall, Brixton, and ordinary meetings are held on the first Tuesday in each month. We understand that the club already numbers more than a hundred members. The President is Mr. Henry Dean, F.L.S., Dr. Braithwaite is one of the Vice-Presidents, and Mr. Frederick Hovenden the Hon. Secretary. The annual subscription has been fixed at ten shillings.

SCIENCE is certainly popular in America. We have received the first number of the *American Journal of Microscopy*, devoted to the elucidation of Scientific and Popular Microscopy, edited by Dr. E. M. Hale, and published at Chicago. A trial number having been issued some months ago met with such a warm reception that the proprietors have determined on a regular monthly issue. The present number contains practical articles on the use of the microscope, and others descriptive of microscopic objects, some of them well illustrated. It promises to be a useful and interesting magazine.

ON February 4, an extraordinary meteor was seen at Pichieani in Peru. It was balloon-shaped, with the pointed end towards the earth, and red-coloured. It descended rapidly to the earth, and its descent was attended by an explosion, leaving a dense cloud over the place. It injured the roofs of several huts, and knocked down a fence for about 500 yards. On the spot, it is reported several dead fish were found of different species, which are supposed to have been lifted out of the river, and dashed against the stones. Similar events happened near Huanochullo and Atucachi.

ON February 22, several shocks of earthquake were felt at Puno in Peru, and on March 6, a slight earthquake of thirty seconds after rain.

IN March a most remarkable electric storm was witnessed at Tacua in Peru. For a few hours the snowy peak of Tacora seemed the centre of conflagration of lightning, nor was the thunder less terrific. The population were the more alarmed as the night before there had been some slight shocks of earthquake.

THE horned toad of Oregon (*Tapaya Douglassii*) is a remarkable creature, plentiful on the open plains of the district among rocks and sand. They are usually grey, but Dr. Cooper states that he met with one example which was of a brick red on the back, but beneath white like the rest. These colours resemble those of the stones among which they live, and it is supposed that they have the chameleon-like property of changing their hue. Though ferocious in appearance, they are perfectly harmless; yet the Indians believe them to have the power of producing a poisonous wound with their blunt spines, just as, among ourselves, the newts are credited with many objectionable qualities. These toads are very slow in motion, and do not attempt to bite. One was kept in captivity for five months without food in a small box, remaining quite lively for the greater part of the time. When irritated, it would spring in a most threatening manner at anything pointed at it, at the same time opening its mouth wide and hissing audibly, after which it would inflate its body, and show other marks of anger.

THE Western gull (*Larus occidentalis*) is very abundant on the whole coast of California, especially on the Farrallone

Islands, where it is a serious hindrance to the men employed in collecting the eggs of the Murre (*Uria Brunnichii* which breeds there in countless numbers. The traffic in their eggs between these islands and San Francisco alone reaches annually the sum of between one and two thousand dollars. The egg-hunters meet at one o'clock every day during the season (from May to July) with the exception of Sundays and Thursdays, and at a given signal, so that each may have an equal chance in gathering the spoil, start off for the most productive egging grounds. The gulls understanding, it would seem, what is to occur, hover overhead, awaiting the advance of the men, who rush eagerly into the rookeries. The affrighted Murres have scarcely risen from their nests, before the gull, with remarkable instinct, flying but a few paces ahead of the hunter, alights on the ground, tapping such eggs as the short time will allow before the egger comes up with him. The broken eggs are passed by the men, who remove only those which are sound. The gull, then returning to the field of its exploits, procures a plentiful supply of its favourite food. Dr. Heermann says that he once saw three gulls scientifically approach a single Murre sitting on her egg. Two of them feigning an attack in front, the Murre raised herself to repel them; instantly the third advancing from the rear seized her solitary egg from beneath her, and flew off with the booty, the two first immediately following to claim their share. The egg was dropped and broke on the rocks, when a general scramble ensued between the three robbers for the valued prize.

AMONG the plants which have received honour and religious veneration among the Hindoos, the Doob-grass (*Cynodon dactylon*) holds a prominent place. Its usefulness, added to its beauty, induced them in their earliest ages to consider it the abode of a benevolent nymph, and it is employed in many of their religious ceremonies. It owes much of its honour to its great tenacity of life, being regarded as an emblem of immortality; and the Véda celebrates it, under one of its names, in words which indicate its supposed mystic origin :—"May *Durvà*, which rose from the water of life, which has a hundred roots and a hundred stems, efface a hundred of my sins, and prolong my existence for a hundred years." The extreme rapidity of growth in this grass is here referred to, and it is stated that, by merely chopping it in pieces and sprinkling these on prepared ground, a verdant sward may be obtained in a few weeks. The Doob-grass is frequently introduced by name in the popular stories of the country, and the roots are esteemed medicinal.

IN the northern district of Alaska the various grasses, which form an important portion of the vegetation, are woven into mats, dishes, articles of summer clothing, such as socks, mittens, and hats, by the Indians and Esquimaux. Mr. W. H. Dall states in his report upon the resources of that region, that in winter the grasses are neatly tied in bunches, and shaped to correspond with the foot; they are then placed between the foot and the sealskin sole of the winter boots worn in that country. "There they serve as a non-conductor, keeping the foot dry and warm, and protecting it from contusion to an extent which the much-lauded moccasins of the Hudson Bay men never do. In fact, I believe the latter to be, without exception, the worst, most uncomfortable, and least durable covering for the foot worn by mortal man."

AMONG other South American districts reported on the point of being reworked are the Cinnabar mines of Santa Barbara in Huancavolico, in Peru, gold and silver mines in Cauca, and copper mines in Doepar, in Colombia or New Granada.

THE Chilian Government has employed the *Cavadonga* war vessel, Captain Gormaz, on surveying duties. Her work begins at Ancud.

## *THE TRANSITS OF VENUS IN 2004 AND 2012* *

WHILE preparations are being made by astronomers of various nations for the observation of the approaching Transit of Venus over the sun's disc in December 1874, it may be of interest to know under what conditions the pair of transits in the twenty-first century will take place. This consideration has induced me to make a careful calculation of the circumstances of the transits in 2004 and 2012, from M. Leverrier's Tables of the Sun and Planet, which at present are extremely accurate, and which there can be little doubt will closely represent the phenomena to be witnessed in those years. The calculations have been made entirely by myself, but with every precaution to avoid error, and I have confidence in the results.

The following are the resulting elements of the transit in 2004 :—

Greenwich mean time of conjunction in right ascension 2004, June 7d 20h 51m 28s·8.

| | | |
|---|---|---|
| Right Ascension of Sun and Venus . . | | 76° 50′ 28″·96 |
| Declination of Sun . . | | +22 53 20·4 |
| ,, Venus . . | | +22 42 52·3 |
| Horary motion in R.A. . . Sun . . | | 2 35·07 |
| ,, . . Venus . . | | −1 47·40 |
| Horary motion in declination Sun . . | | +0 13·00 |
| ,, ,, Venus . . | | −0 43·83 |
| Semi-diameter . Sun . . | | 15 45·74 |
| ,, . Venus . . | | 28·75 |
| Horizontal parallax . . . Sun . . | | 8·78 |
| ,, . . . Venus . . | | 30·85 |

Log. distance of Venus from the Earth . 9·46069

Equation of time . 1m 15s·6 (additive to mean time).

Hence, for the centre of the earth,

| | d | h | m | s | ° | |
|---|---|---|---|---|---|---|
| First external contact = June | 7 | 17 | 3 | 43 | at 115·0 from N. towards E. | For the *direct* image. |
| First internal contact = June | 7 | 17 | 22 | 35 | at 118·0 from N. towards E. | |
| Second internal contact = June | 7 | 23 | 5 | 40 | at 214·6 from N. towards E. | |
| Second external contact = June | 7 | 23 | 24 | 32 | at 218·5 from N. towards E. | |

And $l$ being the geocentric latitude, $\rho$ the radius of the earth at any place, and $\lambda$ the longitude from Greenwich + E, − W., the reductions for parallax will be obtained from

1st ext. cont. = June 7d 17h 3m 43s + [2·2198]$\rho$ . sin $l$ − [2·5932] . $\rho$ . cos $l$ . cos($\lambda$ + 176° 32′).

1st int. cont. = June 7d 17h 22m 35s + [2·2571]$\rho$ . sin $l$ − [2·5765] . $\rho$ . cos $l$ . cos($\lambda$ + 182° 38′).

2nd int. cont. = June 7d 23h 5m 40s − [2·5090]$\rho$ . sin $l$ + [2·4353] . $\rho$ . cos $l$ . cos($\lambda$ + 47° 17′).

2nd ext. cont. = June 7d 23h 24m 32s − [2·4928]$\rho$ . sin $l$ + [2·4631] . $\rho$ . cos $l$ . cos($\lambda$ + 54° 35′).

For the Royal Observatory, Greenwich, I find :—

| | d | h | m | s | |
|---|---|---|---|---|---|
| First external contact, June | 7 | 17 | 9 | 56 | Mean times at Greenwich. |
| ,, internal ,, ,, | | 17 | 28 | 51 | |
| Second internal ,, ,, | | 23 | 3 | 24 | |
| ,, external ,, ,, | | 23 | 22 | 15 | |

Therefore the entire transit will be visible at Greenwich.

Similarly, the elements of the transit of 2012 are found to be: Greenwich mean time of conjunction in right ascension 2012, June 5d 13h 4m 44s·3.

| | | |
|---|---|---|
| Right ascension of Sun and Venus . . | | 74° 31′ 11″·9 |
| Declination of Sun . . | | +22 40 24·1 |
| ,, Venus . . | | +22 50 3·0 |
| Horary motion in R.A..... ..Sun . . | | 2 34·67 |
| ,, ,, Venus . . | | −1 37·70 |
| Horary motion in declination. Sun . . | | +0 15·23 |
| ,, ,, Venus . . | | −0 45·37 |
| Semi-diameter...Sun . . | | 15 46·01 |
| ,, . Venus . . | | 28·77 |
| Horizontal parallax.....Sun . . | | 8·76 |
| ,, ,, Venus . . | | 30·86 |

Log. distance of Venus from the Earth . 9·46042

Equation of time . 1m 19s·8 (additive to mean time).

* "Note on the Circumstances of the Transits of Venus over the Sun's Disc in the years 2004 and 2012." From the Proceedings of the Royal Society.

Hence, for the centre of the earth,

| | d | h | m | s | | |
|---|---|---|---|---|---|---|
| First external contact ... June | 5 | 10 | 22 | 11 | at 40°·3 from N. towards E. | For the *direct* image |
| First internal contact ... June | 5 | 10 | 39 | 56 | at 37°·8 from N. towards E. | |
| Second internal contact ... June | 5 | 16 | 42 | 6 | at 293°·1 from N. towards E. | |
| Second external contact ... June | 5 | 17 | 0 | 0 | at 290°·5 from N. towards E. | |

And, with the same notation as before, I find for the reduction for parallax,

1st ext. cont. = June 5d 10h 22m 11s + [2·4536] $\rho$ . sin $l$ − [2·4582] . $\rho$ . cos $l$. cos($\lambda$ + 41° 28′).

1st int. cont. = June 5d 10h 39m 56s + [2·4838] $\rho$ . sin $l$ − [2·4558[ . $\rho$ . cos $l$. cos($\lambda$ + 43° 52′).

2nd int. cont. = June 5d 16h 42m 6s − [2·1301] $\rho$ . sin $l$ + [2·5968] . $\rho$ . cos $l$. cos($\lambda$ − 10° 57′).

2nd ext. cont. = June 5d 17h 0m 0s − [2·1158] $\rho$ . sin $l$ + [2·5825] . $\rho$ . cos $l$. cos($\lambda$ − 6° 28′).

At Greenwich the egress only will be visible.

| | d | h | m | s | |
|---|---|---|---|---|---|
| Last internal contact June | 5 | at 16 | 44 | 23 | Mean times at Greenwich. |
| ,, external ,, | ,, | at 17 | 2 | 15 | |

The sun will rise at 15h 46m.

J. R. HIND

## AMERICAN NOTES

THE year 1871 bids fair to be marked in the history of American science for the great number of exploring expeditions under the auspices of the United States Government. First, that of Captain C. F. Hall, the well-known Arctic traveller, for whose proposed Polar Exploration the United States steamer *Periwinkle* is now being prepared at the Washington Navy-yard. This vessel, of nearly four hundred tons burden, is said to be very staunch and reliable, and her equipment will be of the best order. It is understood that the expedition will start about the end of May, and that Captain Hall's scientific assistants will be Dr. David Walker, formerly known as the surgeon and physicist of Sir Leopold M'Clintock's expedition in the *Fox*, and Dr. Emil Bessels, who has seen Arctic service in a Spitzbergen expedition. Dr. F. V. Hayden, long known to the public as a geologist and explorer, continues his labours of the past season, with the aid of an appropriation by Congress of 40,000 dols. His party is now being fitted out, and will be provided with the necessary assistants in all branches of research. His work will be to the northward of the scene of his last year's explorations. A third expedition is that of Lieutenant G. M. Wheeler, which, under the direction of the War Department, proceeds to explore certain little-known regions of Arizona and Southern Nevada, including the country about the Lower Colorado and Bill Williams Fork. This work will require several years for its completion. Lastly, Major Powell continues his labours during the present season, and expects to make a careful examination of the Canons of Green River as well as of the Colorado.—Attention was called some time ago to the high scientific value of the collection of objects made by the late Dr. Klemm, of Dresden, for use in his "History of the Progress of Human Civilisation;" and it was suggested that in its great extent, and in the harmonious exhibition of illustrations of human art and handicraft in every department, it would constitute an important addition to the means of instruction in the city of New York. An association of parties in Leipsic has accomplished its purchase, at a cost of over ten thousand dollars; and has determined to make it the basis of an international anthropological museum, which, it is expected, will be one of the most complete in the world. Contributions from all parts of the globe, and especially from America, are invited by the committee having the matter in charge, and we trust that the appeal will not be in vain. —Stimulated by the success of the experiment made by the Phiiadelphians in stocking the Delaware River with black bass, some public-spirited gentlemen of Reading, Pennsylvania, have undertaken to try the same experiment in the Schuylkill, and 350 dollars have already been subscribed for that purpose.—The town of Amherst, in Massachusetts, has followed the example of New York, Philadelphia, Boston, and other places, in introducing English sparrows, in the hope of establishing a colony of these birds.—The San Francisco papers are calling attention to specimens of fossil ivory brought from Alaska; and parties are said to be about entering upon the business of collecting it on a large scale. This ivory consists of the tusks of the mammoth or fossil elephant (*Elephas primigenius*), the remains of which are extremely abundant in Alaska, but much more so in Siberia, from which latter country, as is well known, an appreciable percentage of all the ivory now used in the arts is obtained.—The College of the City of New York in Twenty-third Street, shows a commendable desire to increase its means of instruction in natural history, and particularly in the department of osteology, the president having succeeded by unremitting effort in obtaining means to secure quite a large number of specimens, among which may be especially mentioned a large slab of stone containing a well-preserved skeleton of the *Ichthyosaurus*, or fish-like fossil lizard from the Lias of Germany. The specimen is about ten feet long, and, from its perfection and excellence of preservation, is justly entitled to consideration.

## EXPERIMENTS ON THE SUCCESSIVE POLARISATION OF LIGHT, WITH DESCRIPTION OF A NEW POLARISING APPARATUS*

THE term successive polarisation was applied by Biot to denote the effects produced when a ray of polarised light is transmitted through a plate of rock-crystal cut perpendicularly to the axis, or through limited depths of certain liquids. In these cases the plane of polarisation is found to be changed on emergence, and differently for each homogeneous ray, so that, when white light is employed, on turning the analyser round continuously in one direction different colours successively appear, rising or falling in the scale according to the nature of the substance.

If, while the analyser is turned from left to right, the tints ascend (*i.e.* follow the order R, O, Y, G, B, P, V), the substance is said to exhibit right-handed successive polarisation, but if the tints descend, the successive polarisation is said to be left-handed.

These phenomena were satisfactorily explained by Fresnel in the following way. The incident polarised ray, instead of resolving itself into two plane polarised rays at right angles to each other, as in the ordinary cases of dipolarisation, resolves itself in these instances into two circularly polarised rays, one right-handed the other left-handed, which are transmitted with different velocities; each homogeneous ray, thus resolved into two opposite circularly polarised pencils, on emergence composes a ray polarised in a single plane, the deviation of which from the primitive plane of polarisation depends on the difference of phase of the two circularly polarised rays on emergence.

The rotation of the planes of polarisation is from left to right or from right to left, according to whether the right-handed or left-handed circular rays are transmitted with the greater velocity.

The term dipolarisation, proposed by Dr. Whewell to express the bifurcation which a ray of polarised light suffers when it is transmitted through a crystallised plate, is a very appropriate one; but as there are different kinds of such separation, we may designate plane dipolarisation the resolution into two plane-polarised rays at right angles to each other, and circular dipolarisation the resolution into two circularly polarised rays, one right-handed the other left-handed. In like manner the term elliptic dipolarisation may be employed to represent the phenomena shown by transmitting a polarised ray through a plate of rock-crystal obliquely to the axis.

The object of the present communication is to make known another means of producing successive polarisation, both right-handed and left-handed, which, equally with the well-known modes, may be proved to arise from the interference of two opposite systems of circularly polarised rays.

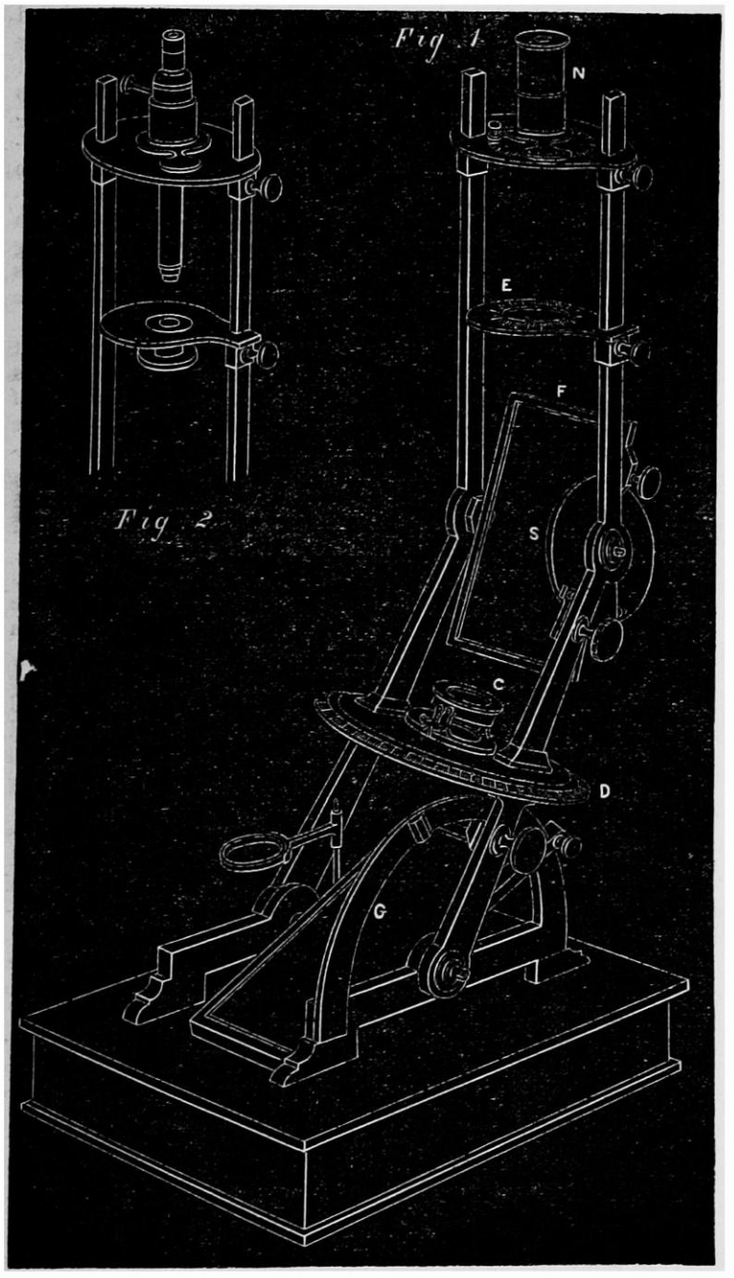
The polarising apparatus which I have employed for the experiments I am about to detail is represented by Fig. 1.

A plate of black glass, G, is fixed at an angle of 3° to the horizon. The film to be examined is to be placed on a diaphragm, D, so that the light reflected at the polarising angle from the glass plate shall pass through it at right angles, and after reflection at an angle of 18° from the surface of a polished silver

* From the Proceedings of the Royal Society.

plate S, shall proceed vertically upwards. N is a Nicol's prism, or any other analyser, placed in the path of the second reflection. The diaphragm is furnished with a ring, moveable in its own plane, by which the crystallised plate to be examined may be placed in any azimuth. C is a small moveable stand, by means of which the film to be examined may be placed in any azimuth and at any inclination ; for the usual experiments this is removed.

If a lamina of quartz cut parallel to the axis, and sufficiently thin to show the colours of polarised light, be placed upon the diaphragm so that its principal section (*i.e.* the section containing the axis) shall be 45° to the *left* of the plane of reflection, on turning the analyser from left to right, instead of the alternation of two complementary colours at each quadrant, which appear in the ordinary polarising-apparatus, the phenomena of successive polarisation, exactly similar to those exhibited in the ordinary

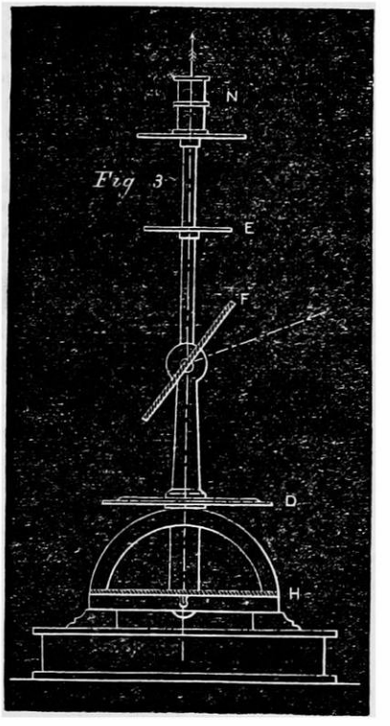



apparatus by a plate of quartz cut perpendicular to the axis will be exhibited : the colours follow in the order R, O, Y, G, B, P, V, or, in other words, ascend as in the case of a right-handed plate of quartz cut perpendicularly to the axis. If the lamina be now either inverted, or turned in its own plane 90°, so that the principal section shall be 45° to the right of the plane of reflection, the succession of the colours will be reversed, while the analyser moves in the same direction as before, presenting the same phenomena as a left-handed plate of quartz cut perpendicularly to the axis. Quartz is a positive doubly refracting crystal, and in it consequently the ordinary index of refraction is smaller than the extraordinary index. But if we take a lamina of a negative crystal, in which the extraordinary index is the least, as a film of Iceland spar split parallel to one of its natural cleavages, the phenomena are the reverse of those exhibited by quartz ; when the principal section is on the *left* of the plane of reflection the colours descend, and when it is on the *right* of the same plane the colours ascend, the analyser being turned from left to right.

It has been determined that the ordinary ray, both in positive and negative crystals, is polarised in the principal section while the extraordinary ray is polarised in the section perpendicular thereto. It is also established that the index of refraction is inversely as the velocity of transmission. It follows from the above experimental results, therefore, that when the resolved ray whose plane of polarisation is to the left of the plane of reflection is the quickest the successive polarisation is right-handed, and when it is the slowest the successive polarisation is left-handed ; in the order R, O, Y, G, B, P, V, and in the second case in the reversed order.

The rule thus determined is equally applicable to laminæ of biaxal crystals.

As selenite (sulphate of lime) is an easily procurable crystal, and readily cleavable into thin laminæ capable of showing the colours of polarised light, it is most frequently employed in experiments on chromatic polarisation. The laminæ into which this substance most readily splits, contain in their planes the two




optic axes ; polarised light transmitted through such laminæ is resolved in two rectangular directions, which respectively bisect the angles formed by the two optic axes ; the line which bisects the smallest angle is called the intermediate section, and the line perpendicular thereto which bisects the supplementary angle is called the supplementary section. These definitions being premised, if a film of selenite is placed on the diaphragm, with its intermediate section to the left of the plane of reflection, the successive polarisation is direct or right-handed ; if, on the contrary, it is placed to the right of that plane, the successive polarisation is left-handed. The ray polarised in the intermediate section is therefore the most retarded ; and as that section is considered to be equivalent to a single optic axis, the crystal is positive.

In one kind of mica the optic axes are in a plane perpendicular to the laminæ. They are inclined 22½° on each side the perpendicular within the crystal, but owing to the refraction, are seen respectively at an angle of 35°·3 therefrom.

The principal section is that which contains the two optic axes. If the film is placed on the diaphragm with its principal section inclined 45° to the left of the plane of reflection, the successive polarisation is right-handed. The ray therefore polarised in the section which contains the optic axes is the one transmitted with the greatest velocity.

Films of uniaxal crystals, whether positive or negative, and of biaxal crystals, all agree therefore in this respect ; that if the plane of polarisation of the quickest ray is to the left of the plane

of reflection, the successive polarisation is right-handed when the analyser moves from left to right, and if it is to the right of the plane of refraction, other circumstances remaining the same, the successive polarisation is left-handed.

It must be taken into consideration that the principal section of the film is inverted in the reflected image, so that if the plane of polarisation of the quickest ray in the film is to the left of the plane of reflection, it is to the right of that plane in the reflected image.

It may not be uninteresting to state a few obvious consequences of this successive polarisation in doubly refracting laminæ, right-handed and left-handed according to the position of the plane of polarisation of the quickest ray. They are very striking as experimental results, and will serve to impress the facts more vividly on the memory.

1. A film of uniform thickness being placed on the diaphragm with its principal section 45° on either side the plane of reflection, when the analyser is at 0° or 90°, the colour of the film remains unchanged, whether the film be turned in its own plane 90°, or be turned over so that the back shall become the front surface; but if the analyser be fixed at 45°, 135°, 225°, or 315°, complementary colours will appear when the film is inverted from back to front, or rotated in its own plane either way 90°.

2. If a uniform film be cut across and the divided portions be again placed together, after inverting one of them, a compound film (fig 4) will be formed, which, when placed on the diaphragm, will exhibit simultaneously both right-handed and left-handed successive polarisation. When the analyser is at 0° or 90° the colour of the entire film uniform; as it is turned round the tints of one portion ascend, while those of the other descend; and when the analyser is at 45° or $n90° + 45°$, they exhibit complementary colours.

3. A film increasing in thickness from one edge to the other is well suited to exhibit at one glance the phenomena due to films of various thicknesses. It is well known that such a film placed between a polariser and an analyser will show, when the two planes are parallel or perpendicular to each other, and the principal section of the film is intermediate to these two planes, a series of parallel coloured bands, the order of the colours in each band from the thick towards the thin edge being that of their refrangibilities, or R, O, Y, G, B, P, V. The bands seen when the planes are perpendicular, are intermediate in position to those seen when the planes are parallel; on turning round the analyser these two systems of bands alternately appear at each quadrant, while in the intermediate positions they entirely disappear.

Now let us attend to the appearances of these bands when the wedge-form film is placed on the diaphragm of the instrument, Fig. 1. As the analyser is moved round the bands advance towards or recede from the thin edge of the wedge without any changes occurring in the colours or intensity of the light, the same tint occupying the same place at every half revolution of the analyser. If the bands advance towards the thin edge of the wedge, the successive polarisation of each point is left-handed; and if they recede from it the succession of colours is right-handed; every circumstance, therefore, that with respect to a uniform film changes right-handed into left-handed successive polarisation, in a wedge of the same substance transforms receding into advancing bands, and *vice versâ*. These phenomena are also beautifully shown by concave or convex films of selenite or rock-crystal, which exhibit concentric rings contracting or expanding in accordance with the conditions previously explained.

4. Few experiments in physical optics are so beautiful and striking as the elegant pictures formed by cementing laminæ of selenite of different thicknesses (varying from $\frac{1}{2000}$ to $\frac{1}{50}$ of an inch) between two plates of glass. Invisible under ordinary circumstances, they exhibit, when examined in the usual polarising apparatus, the most brilliant colours, which are complementary to each other in the two rectangular positions of the analyser. Regarded in the instrument, Fig. 1, the appearances are still more beautiful; for, instead of a single transition, each colour in the picture is successively replaced by every other colour. In preparing such pictures it is necessary to pay attention to the direction of the principal section of each laminæ, when different pieces of the same thickness are to be combined together to form a surface having the same uniform tint; otherwise in the intermediate transitions the colours will be irregularly disposed.

5. A plate of rock-crystal cut perpendicular to the axis loses its successive polarisation, and behaves exactly as an ordinary crystallised film through which rectilinear polarised light is transmitted.

6. A thick plate of unannealed glass undergoes a series of regular transformation,

The phenomena of successive or rotatory polarisation I have experimentally demonstrated admit of a very simple explanation.

The polarised light incident on the crystallised plate is resolved into two portions of equal intensity polarised at right angles to each other, one in the principal section, the other perpendicular thereto. These resolved portions, when they fall on the silver plate, have their planes of polarisation each at an azimuth of 45°, one to the right, the other to the left of the plane of reflection. These are again resolved in the plane of reflection and the plane perpendicular thereto, and are in consequence of the unequal retardation, which in silver at an angle of 72° amounts to a quarter of an undulation, converted into circularly polarised beams, one right-handed, the other left-handed.

The various homogeneous rays being accelerated differently in their transmission through the two sections of the crystallised plate this difference is preserved after reflection from the silver plate, and the oppositely circularly polarised beams are reflected with the same difference of phase as the two plane-polarised rays are when emerging from the crystallised lamina. The composition of two circular waves, one right-handed the other left-handed, gives for resultant a plane wave, the azimuth of which varies with the difference of phase of the two components.

When the plane of polarisation does not lie equally between the two rectangular sections of the laminæ, these still remaining 45° from the plane of reflection of the silver plate, the beam is resolved into two unequal portions, the amplitudes of which are as sin $a$, to cos $a$.

Each therefore gives rise to a circular undulation of different amplitude. The resultant of two opposite circular undulations of different amplitudes is an ellipse of constant form, the axes of which vary in position according to the difference of phase. The same phenomena of successive polarisation are therefore exhibited in whatever azimuth the laminæ is turned in its own plane, but the tints become fainter and fainter until ultimately, when the principal or perpendicular section is parallel to the plane of reflection of the polarising plate, all colour disappears.

By means of the phenomena of successive polarisation it is easy to determine which is the thicker of two films of the same crystalline substance. Place one of the films on the diaphragm ($a$) of the instrument (Fig. 1 $a$) in the position to show, say, right-handed polarisation, then cross it with the other film; if the former be the thicker, the successive polarisation will be still right-handed; if both be equal there will be no polarisation; and if the crossed film be the thicker, the successive polarisation will be left-handed. In this manner a series of films may be readily arranged in their proper order in the scale of tints.

In the experiments I have previously described the planes of reflection of the polarising-mirror and of the silver plate were coincident; some of the results obtained when the azimuth of the plane of reflection of the silver plate is changed are interesting.

I will confine my attention here to what takes place when the plane of reflection of the silver plate is 45° from that of the polarising-reflector.

When the principal sections of the film are parallel and perpendicular to the plane of reflection of the polarising mirror, as the whole of the polarised light passes through one of the sections no interference can take place, and no colour will be seen, whatever be the position of the analyser.

When the principal sections of the film are parallel and perpendicular to the plane of reflection of the silver plate, they are 45° from the plane of reflection of the polarising mirror.

The polarised ray is then resolved into two components polarised at right angles to each other, one component is polarised in the plane of reflection of the silver plate, the other perpendicular thereto; and one is retarded upon the other by a quarter of an undulation.

When the analyser is 0° or 90° no colours are seen, because there is no interference; but when it is placed at 45° or 135°, interference takes place, and the same colour is seen as if light circularly polarised had been passed through the film. The bisected and inverted film shows simultaneously the two complementary colours.

But when the film is placed with one of its principal sections $22\frac{1}{2}°$ from the plane of reflection of the polarising-mirror, on turning round the analyser the appearances of successive polarisation are reproduced exactly as when the planes of reflection of the silver plate and of the polarising-mirror coincide. In this

case the components of the light oppositely polarised in the two sections are unequal, being as cos 22½° to sin 22½°; these components respectively fall 22½° from the plane of reflection of the silver plate and from the perpendicular plane, and are each resolved in the same proportion in these two planes. The weak component of the first, and the strong component of the second, are resolved into the normal plane, while the strong component of the first and the weak component of the second are resolved into the perpendicular plane.

As bearing intimately on the subject of this paper, I will here quote a passage from a memoir presented by Fresnel to the French Academy of Sciences in 1817, and published, in abstract, in the "Annales de Chimie," t. xxviii., 1825:--

"If a thin crystallised plate be placed between two parallelopipeds of glass crossed at right angles, in each of which the light previously polarised undergoes two total reflections at the incidence of 54½°, first before its entrance into the plate (which we suppose perpendicular to the rays), and subsequently after its emergence; and if, besides, the plate be turned so that its axis makes an angle of 45° with the two planes of double reflection, this system will present the optical properties of plates of rock crystal perpendicular to the axis, and of liquids which colour polarised light. When the principal section of the rhomboid with which the emergent light is analysed is turned round, the two images will gradually change colour, instead of experiencing only simple variations in the vividness of their tints, as occurs in the ordinary case of thin crystallised plates; besides, the nature of these colours depends only on the respective inclination of the primitive plane of polarisation and the principal section of the rhomboid, that is to say, of the two extreme planes of polarisation; thus, when this angle remains constant, the system of the crystallised plate and the two parallelopipeds may be turned round the transmitted pencil without changing the colour of the images. It is this analogy between the optical properties of this little apparatus and those of plates of rock-crystal perpendicular to the axis which enabled M. Fresnel to foresee the peculiar characters of double refraction that rock-crystal exerts on rays parallel to the axis."

It does not appear that Fresnel, in any of his published memoirs, has given any further modifications of this experiment, the importance of which has been almost entirely overlooked in elementary treatises on light. He does not seem to have remarked that similar phenomena of successive polarisation are exhibited when the light incident on the crystallised plate is plane polarised, nor that the order of the succession of the colours depends on the position of the principal section with respect to the plane of polarisation. These circumstances are indeed necessarily included in the beautiful theory established by this eminent philosopher; but I am not aware that they have hitherto been specifically deduced or experimentally shown.

The apparatus (Fig. 1) affords also the means of obtaining large surfaces of uncoloured or coloured light in every state of polarisation, rectilinear, elliptical, or circular.

It is for this purpose much more convenient than a Fresnel's rhomb, with which but a very small field of view can be obtained. It must, however, be borne in mind that the circular and elliptical undulations are inverted in the two methods; in the former case they undergo only a single, in the latter case a double reflection.

For the experiments which follow, the crystallised plate must be placed on the diaphragm E between the silver plate and the analyser, instead of as in the preceding experiments, between the polariser and the silver plate.

By means of a moving ring within the graduated circle D the silver plate is caused to turn round the reflected ray, so that while the plane of polarisation of the ray remains always in the plane of reflection of the glass plate, it may assume every azimuthal position with respect to the plane of reflection of the silver plate. The film to be examined and the analyser move consentaneously with the silver plate, while the polarising mirror remains fixed.

In the normal position of the instrument the ray polarised by the mirror is reflected unaltered by the silver plate; but when the ring is turned to 45°, 135°, 225°, or 315°, the plane of polarisation of the ray falls 45° on one side of the plane of reflection of the silver plate, and the ray is resolved into two others polarised respectively in the plane of reflection and the perpendicular plane, one of which is retarded on the other by a quarter of an undulation, and consequently gives rise to a circular ray, which is right-handed or left-handed according to whether the ring is turned 45° and 225°, or 135° and 315°. When the ring is turned so as to place the plane of polarisation in any intermediate position between those producing rectilinear and circular light, elliptical light is obtained on account of the unequal resolution of the ray into its two rectangular components.

Turning the ring of the graduated diaphragm from left to right when the crystallised film is between the silver plate and the analyser, occasions the same succession of colours for the same angular rotation as rotating the analyser from right to left when the instrument is in its normal position, and the film is between the polariser and the silver plate.

To arrange the apparatus for the ordinary experiments of plane-polarised light without the intervention of the silver plate, all that is necessary is to remove the silver plate from the frame F, and to substitute for it a plate of black glass, which must be fixed at the proper polarising-angle.

To convert it into a Norrenberg's polariser, a silver mirror must be laid horizontal at H, and the instrument straightened, as shown at Fig. 3, so that a line perpendicular to the mirror shall correspond with the line of sight. The silver plate must be removed from the frame F, and a plate of transparent glass substituted for it, which must be so inclined that the light falling upon it shall be reflected at the polarising-angle perpendicularly towards the horizontal mirror. The eye will receive the polarised ray reflected from the mirror, and the polarised ray will have passed, before it reaches the eye, twice through a crystallised plate placed between the mirror and the polariser. The result is the same as if, in the ordinary apparatus, the polarised plate had passed through a plate of double the thickness.

Fig. 2 shows the addition to the apparatus when the coloured rings of crystals are to be examined by light circularly or elliptically polarised; *a* is the optical tube containing the lenses, which require no particular explanation, and *b* the condenser over which the plate is to be placed.

C. WHEATSTONE

## SCIENTIFIC SERIALS

IN the *Journal of Botany* for April, Mr. Hiern concludes his exhaustive paper On the Forms and Distribution over the World of the Batrachian Section of *Ranunculus*; Mr. J. G. Baker his Monograph of the Liliaceous genus *Xiphion*; and we have also the conclusion of the valuable List of New Species of Phanerogamous plants published in Great Britain during the year 1870. Mr. Hiern's paper concludes with a mathematical statement of the form of the leaf of water-plants dependent on the strength of the current. Mr. Carruthers reviews the Contributions to Fossil Botany published in Britain in 1870, which are very few in number.

IN the *Scottish Naturalist* for April, Dr. Lauder Lindsay commences his second paper on Natural Science Chairs in our Universities, and the editor, Dr. Buchanan White, concludes his details of "Sugaring, how, when, and where to do it." Under the head of zoology, Dr. D. Sharp gives an interesting account of the Coleoptera of the Scotch Fir, and Mr. Robert Gray a history of the Capercaillie. The contributions to phytology are a short paper on Scottish plant-names; and a List of Mosses found in the vicinity of Forres, by the Rev. James Keith. Some of the shorter paragraphs contain also interesting information. We would suggest to the conductors of the *Naturalist* whether it is not possible to avoid the very objectionable practice of dividing their papers in the very middle of a sentence. The present number commences ". . . . waist." in the midst of the Editor's article on Sugaring, and concludes "Knowledge is likely to . . . ." in Dr. Lauder Lindsay's on the University Chairs. It is too great a stretch on the memory to expect an incomplete sentence to be kept in the head for three months; and the previous number is not always at hand to remind one of the connection.

## SOCIETIES AND ACADEMIES

### LONDON

Royal Society, April 20.—"Research on a New Group of Colloid Bodies, containing Mercury, and certain members of the series of Fatty Ketones." By J. Emerson Reynolds, M.R.C.P. Edin., &c.

"On the Existence and Formation of Salts of Nitrous Oxide." By Edward Divers, M.D.

**Geologists' Association**, April 10.*—A numerous party of the members of the Geologists' Association visited Cambridge for the purpose of inspecting the Woodwardian Museum and the exposures of Cretaceous strata in the neighbourhood. On arriving at Cambridge the party proceeded at once to the Woodwardian Museum, where they were met by the Rev. Dr. Cookson, Master of St. Peter's College, the Rev. J. Wiltshire, M.A., President of the Association, Prof. Morris, the Rev. T. G. Bonney, Fellow and Tutor of St. John s College, the Rev. Osmond Fisher, M.A., and Rev. Harry Seeley, F.G.S., as the representative of the venerable Prof. Sedgwick, who, much to his regret, was prevented being present. The fine collection of fossil mollusca was ably described by the Rev. T. G. Bonney, and the reptilian remains formed the subject of an interesting discourse by Rev. H. Seeley; after which Prof. Morris, in the Geological Lecture Theatre, delivered an address on the geology of the country around Cambridge, which was listened to with great interest by a large audience, who passed a very cordial vote of thanks to the Professor for his lecture. The afternoon was devoted to a visit to the "coprolite workings" and other excavations at Barnwell. Proceeding along the banks of the Cam a fine section of Pleistocene deposits yielding mammaliferous remains and the usual species of mollusca was reached. This exposure exhibited some very fine examples of false bedding, and many granite and other boulders from the drift were here seen. A very extensive excavation in the Gault here capped by a thin deposit of Upper Greensand lower chalk was next visited. The Gault, excavated for brick making purposes, is exposed to a depth of seventy or eighty feet, and from the evidence of well-sinkers it is probably from 150 to 200 feet thick. Fossils are rarely met with in the Gault clay at this place, though in other localities this formation is very fossiliferous. Lying on the Gault at its junction with the Upper Greensand beds before mentioned occurs the stratum containing the phosphatic nodules or "Coprolites" for which this locality is famous, and which, from another locality, were first noticed as being valuable for agricultural purposes by Prof. Henslow. At a short distance from this excavation the coprolite workings are found on all sides. Indeed, the whole of the land in the neighbourhood is being systematically explored for these valuable nodules which lie at an average of six or seven feet from the surface. One field after another is taken in hand, the coprolite bed of about twelve inches in thickness is taken out, the soil is carefully replaced on the surface, and the field is once again ready for tillage. The "coprolites" are washed by horse power to remove the sand and loam in which they are imbedded, and they are then ready for conversion into manure. A considerable number of fossils, chiefly Brachiopods, were obtained. The party returned to Cambridge, and in the evening were most hospitably entertained at St. John's College by the Rev. T. G. Bonney. On the following day Upware, between Cambridge and Ely, was visited. At this place, situated in the fens and near to the river Cam, very interesting sections have been exposed in consequence of the search for "coprolites." The Gault, which has become very thin, has been cut through and Lower Greensand strata reached. In the Lower Greensand, as at the top of the Gault, a bed abounding in the so-called coprolites is found, and this bed contains characteristic Lower Greensand fossils, together with several new species of Brachiopods described by Rev. J. F. Walker, B.A., F.G.S. Cropping out within a very short distance of this exposure of Gault and Lower Greensand is a remarkable calcareous rock full of corals, which has hitherto been called Coral Rag, but which Rev. Harry Seeley, who has paid great attention to the strata of this district considers to be of Kimmeridgian age, and to which he has applied the name Upware Limestone. This rock is underlain by "Ampthill clay," which would appear to be in this district the equivalent of the Coral Rag of Oxfordshire, Gloucestershire, Dorsetshire, &c. The Brachiopods in the Lower Greensand coprolitic bed are abundant, especially *Terebratula sella*, *Terebratula prælonga*, and *Waldheimia* (*Terebratula*) *Davidsoni*. The next excursion of the Association will be to Belvedere and Erith on Saturday next, and during May visits will be paid to Oxford, Grays in Essex, and Yeovil in Somersetshire.

**Anthropological Institute**, April 17.—Sir John Lubbock, Bart., president, in the chair. Messrs. Marsden Gibson, Adam Murray, Charles Rooke, and Thomas Davey, were elected members. Mr. F. G. H. Price exhibited a pick made from the antlers of the red deer. Mr. Charlesworth exhibited an ancient Mexican flake of obsidian, an obsidian core, and a Mexican mirror of iron pyrites.—A paper by Dr. W. H. J. Bleek was read on the position of the Australian Languages. After pointing out the discovery, made by Sir George Grey, that the languages spoken throughout the southern portion of the Australian Continent were derived from one common stock, the author proceeded to inquire what relationship they bore to other languages. It was shown that in structure they were diametrically opposed to Polynesian languages; that they had remarkable resemblances to the Drâvidian or South-Indian languages, and should be placed with the latter in the same class. The author gave a comprehensive sketch of the characteristics of the Turanean languages, their modifications and varieties. From the linguistic point of view Dr. Bleek had arrived at the conclusion that the Australian native was, probably, mainly a degenerate offspring of the South-Indian race, and it was possible that the latter might have some admixture of negro blood, although their physical features would not altogether bear out that conclusion. It was not improbable that some portion of the negro race occupied the tropical districts of India. It would appear from a comparison of the religious customs and observances of the past with those of the present time among the Australian aborigines that those people had fallen from a higher civilisation; and that conclusion would seem to be borne out by a consideration of the artificial nature of their weapons, their knowledge of the art of spinning, the peculiar system of castes existing among them, and from other circumstances tending to confirm that view. It was not too much to say that their having been spread in small numbers over a vast continent produced almost necessarily with them, as with many European settlers in new countries, the loss of many of those acquirements of civilisation which they had original possessed.—The Rev. G. Taplin contributed "A comparative table of the Australian languages."—Mr. C. S. Wake read a paper on the mental characteristics of primitive man, as exhibited in the Aborigines of Australia. With reference to the subject of religion the author maintained that as the aborigines could not be said to have any worship at all the argument that they had been derived from inhabitants of the temperate zone was not of any value. That the Australian aborigines did possess certain points of affinity with other races was, in his mind, unquestionable. Those points of affinity, however, did not prove that the Australians had fallen from a higher state of civilisation, or that as a race they had been derived either from Southern India or from Northern Asia. A race, whatever degradation it might undergo, could never lose all trace in its social condition of that which it once possessed, and sink back to the exact state in which it must have been when it first emerged from a condition of barbarism.

**Mathematical Society**, April 13.—Mr. W. Spottiswoode, F.R.S., president, in the chair. Mr. C. J. Monro, B.A., late Fellow of Trinity College, Cambridge, was proposed for election, and the following gentlemen were elected members:—The Hon. J. W. Strutt, Major Frederick Close, R.A., and Mr. James Stuart, Fellow and Tutor of Trinity College, Cambridge.—The President briefly alluded to the loss the society had recently experienced by the death of its first President, the late Prof. De Morgan. Dr. Hirst, who had been intimately associated with Mr. De Morgan, when both were Professors in University College, gave a sketch of the work done by the deceased professor, especially dwelling upon the originality and acuteness displayed in all his writings, instancing, in particular, his "Double Algebra," his work on the "Differential and Integral Calculus," and his "Formal Logic." The speaker also dwelt upon the warm interest he had taken in the society from its first establishment, which led him to accept the office of first President, and to deliver the inaugural address, and then proceeded to pay a cordial tribute to his personal character. In conclusion, Dr. Hirst stated that Mr. De Morgan's valuable and unique collection of curious works bearing upon the "History of Mathematics," greatly enriched by the owner's own numerous and characteristic quotations, was, he believed, to be disposed of. Several members present expressed their wish that the collection might not be dispersed, but be secured in its entirety for the London University or for the British Museum.—Prof. Crofton, F.R.S., then explained his diagrams in illustration of the "Stresses in Warren and Lattice Girders." Prof. Henrici and Mr. Merrifield, in their remarks on the communication, drew attention to the fact that Mr. Crofton had been anticipated in his constructions in a work by K. Culmann, "Die Graptische

* Communicated by Prof. Morris.

Statik" (1866), who had not only treated this particular matter in a freer manner, but applied his methods to a much wider range of subject. Prof. Henrici further illustrated the subject of the communication by a very simple and ingenious construction.—Prof. Cayley, V.P., followed with a brief sketch of the contents of his third memoir on "Quartic Surfaces."

**Institution of Civil Engineers**, April 18.—Mr. Charles B. Vignoles, F.R.S., president, in the chair.—"On the Archimedean Screw Propeller, or Helix, of Maximum Work," by Sir F. C. Knowles, Bart. In considering the construction and action of the Griffiths' Screw Propeller, the author of this memoir was struck by the fact that the blades worked in great part in the lateral streams of the water, and had no action in the dead water behind the sternpost, where power applied ought to be the most efficient. Again, in the common screw propeller at all points near the axis, the power was almost wholly employed in churning the water, and in producing vibration by alternately lifting and depressing the stem, which no doubt induced Mr. Griffiths to limit the extent of his blades to points without that space. These considerations led to an endeavour to devise some form of blade which should be free from that imperfection, and yet on the whole possess the feathering property of the Griffiths' screw. But no particular form presenting itself which on principle could be pronounced preferable to any other form, the author decided upon proceeding to an *a priori* solution of the question, and assuming the existence of some best form, he was ultimately led to propose this problem: "What is the form of the surface of the screw propeller of which the 'work done' is the greatest possible?" The complete solution of this problem was the subject of the paper, and the following was an outline of the methods employed, and of the results obtained. Referring the required surface to three rectangular co-ordinates $x$, $y$, and $z$, one in the axis of rotation, the other two in the plane of rotation, the author first obtained a general expression for the total "work done" by the blade in propelling the ship, in the form of a double integral in terms of the co-ordinates $x$ and $y$ and of the partial differentials of $z$ with respect to each of them, of the speed of rotation of the blade, and lastly of the speed of the ship. As this integral was to be a maximum for all points of the surface sought, it must be treated by the known methods of the Calculus of Variations. This done, an equation of condition was obtained, which, by the performance of the operations indicated by the symbols, led to an equation involving two factors, each factor being a partial differential equation between the three co-ordinates of the surface. The first of these being integrated gave for its solution the whole family of ordinary helices which were the surfaces of *least* work. The second factor was the differential equation of the required surface, the treatment of which was given in the paper *in extenso*. It led at once, and very simply, to an equation analogous to that of the common

$$\text{helix } \left(\tan.\ \theta = \frac{a \tan.\ a}{r}\right) \text{ namely, } \tan.\ {}^2\theta = \frac{a \tan.\ 2a}{r}$$

From this it was at once deducible, that the surface of the blade at the axis cut the plane of rotation at an angle of 45°, while the common helix cut it at 90°, and therefore acted powerfully in the dead water to propel the ship, just where the common helix had no propulsive power. It was proposed to call this surface the hemi-helix, or hemi-angular helix.—The paper then proceeded to determine the pressure of this blade upon the vessel in the direction of the keel, and thence the whole circumstances of the ship's motion. It was found that there was what was called "a slip," as in the case of the common helix. The author objected to this term, as involving a fallacious theory of the action of the screw,—in effect a denial of the equality of action and reaction. In order fully to expose the fallacy, the motion of a ship impelled by the common helix as a case of variable motion in a resisting medium was investigated, and, from the identity of the conditions and of their algebraical expressions it was proved that what was called "slip" of the screw was neither more nor less than "the ratio of the difference between the velocity which the ship would have in a non-resisting medium and its actual terminal velocity in the water to the former velocity." It was proposed, therefore, to substitute for this objectionable expression the term "ratio of resistance," or "relative resistance," as accurately representing the real phenomena, and measuring the efficiency of the given screw in propelling the given vessel. The author was thus further enabled to explain what had been called "negative slip," and to assign its origin to the joint action of wind and steam, it being impossible in the case of steam alone. In the course of the discussion, objection was taken to the fundamental principles enunciated in the paper; although those principles used to be almost universally promulgated in mathematical treatises of reputed authority, and were commonly even now relied on as the basis of mathematical reasoning, by those whose investigations and experimental researches had not obliged them to detect their unsatisfactory character. Reference was made, in the first place, to what might be called the very foundation of the author's deductive process,—the proposition that when a plane moved obliquely through a fluid at a given velocity, the normal pressure on its surface was as the square of the sine of the angle of obliquity. In the second place, to the hypothesis that when the true law of pressure on a plane thus moving had been in any way determined, the local pressure on each unit of surface of a curved surface moving through a fluid could also be determined, by applying that law to the unit in virtue of the angle presented by its tangent plane to the line of motion. And thirdly to what appeared to be a misconception of the dynamical relations, or inherent conditions of the slip of the propeller.

**Zoological Society**, April 18.—Dr. E. Hamilton in the chair. The Secretary read a report on the additions that had been made to the society's collection during the month of March, 1871. Amongst these particular attention was called to a young male specimen of the Cape hunting dog (*Lycaon pictus*), a species which had been deficient to the society's collection since 1855.—Mr. H. E. Dresser exhibited a specimen of the American yellow-billed cuckoo (*Coccyzus americanus*), recently killed in England, and Sir Victor Brooke a specimen of the Esquimaux curlew (*Numenius borealis*), lately killed in Ireland.—Prof. Owen, F.R.S., read a paper on the dodo (*Didus ineptus*), containing notes on an articulated skeleton of this extinct bird, recently prepared from bones exhumed by Mr. Clark in the Mauritius, and now exhibited in the Ornithological Gallery of the British Museum.—A paper was read by Mr. Thomas Davidson, F.R.S. (communicated by Mr. J. Gwyn Jeffreys), containing a revised account of the recent Brachiopoda dredged by Mr. Arthur Adams in the Japanese Seas.—Messrs. Sharpe and Dresser pointed out the characters of a new form of long-tailed titmouse, which occurs in Southern Spain and in Italy, and which they proposed to call *Acredula irbii*.—Mr. R. B. Sharpe read the second part of his "Contributions to the Ornithology of Madagascar," in which was given an account of a collection of birds recently made by Mr. Crossley in that island. Among these were a specimen of a new swift proposed to be called *Cypselus gracilis*.—A communication was read from Dr. A. Günther, F.R.S., containing the description of a new form of percoid fishes from the Macquarie River, Australia, which he proposed to call *Ctenolates macquariensis*.—A communication was read from Dr. James C. Cox, containing descriptions of some new species of land and marine shells, from Australia and the Southern Pacific.—Two communications were read from Mr. J. Brazier. The first contained descriptions of some new land-shells from New South Wales—the second notes on some species of shells recently described by other authors from the Australian region.

**Chemical Society**, April 20.—Prof. Odling, F.R.S., vice-president, in the chair. The following gentlemen were elected fellows: C. C. Grundy, J. B. Lee, G. Sutcliffe, W. Ward. Mr. C. Haughton Gill read a paper on some saline compounds of cane sugar. The author having succeeded in obtaining a crystalline compound of sodic chloride with cane sugar, mixed a number of sugar solutions with different salts and set them to crystallise spontaneously, or when no crystals were obtained by these means a more rapid evaporation was tried. The salts employed were the chlorides of potassium, sodium, lithium, and ammonium; the bromides of potassium and sodium, and the iodides of potassium, sodium, lithium, and ammonium. None of the potassium salts gave compounds of a definite composition. The sodium salts gave much better results; there were two varieties of sodic chloride compounds formed, constituted respectively $2\ (C_{12}H_{22}O_{11})\ .\ 3\ Na\ Cl\ .\ 4\ H_2O$ and $C_{12}H_{22}O_{11}\ .\ Na\ Cl\ .\ 2\ H_2O$; the solutions containing sodic bromide gave crystals of the composition $C_{12}H_{22}O_{11}\ .\ Na\ Br\ .\ 1\frac{1}{2}\ H_2O$, they were probably not quite pure; the sodic iodide combination, $2\ (C_{12}H_{22}O_{11})\ .\ 3\ NaI\ .\ 3\ H_2O$, formed very fine crystals. The mixture containing lithium gave only crystals of pure cane sugar. The constitution of the sodic iodide compound makes it seem probable that the true molecular weight of cane sugar

should be represented by $C_{24}H_{44}O_{22}$. The measurements of the crystals mentioned in Mr. Gill's paper were executed by Prof. Miller.

### PARIS

Academy of Sciences, April 3.—The account of this sitting is printed in the *Journal Officiel*, the first time since the beginning of the investment of Paris. The account was signed and written by M. Henry de Parville.—M. Simon Newcomb was present at the sitting, and read a communication on the perturbations in the motion of the moon, owing to the attraction of the different planets. The American astronomer proposes to solve this great question, by a new method. The problem is to be solved by one hundred and fifty different equations! M. Newcomb admits it is quite impossible to solve it, without some startling simplification. The present communication is to show the Institute the way through which the author hopes to realise these simplifications. It is not the final work, which, if it is successful, will prove M. Newcomb has made a great analytical discovery. But in such a matter *experience passe science*. M. Delaunay offered no remark on the subject, although he has devoted to it the greater part of his life. He remains on the defensive.—M. Robin, the celebrated microscopist, handed a note on the analysis of blood taken from a man attacked by scurvy. The author shows, from observations made at Necker and Gros Caillou Hospitals, that under these circumstances many white globules are mixed in the blood. But leucocithemic having been observed in other affections, it cannot be considered as a specific character of that dangerous affection so common in besieged towns, and which was frequently observed in Paris towards the end of 1870.

The candidates for the great prize for curing cholera are not easily frightened by the civil war. The premium of 4,000*l.*, given by the late M. Breaut, is worth incurring any risk. A M. Drouet sends a note giving the true cure. The process is simple enough. It is sufficient to cover the stomach of the patient with the film of a collodion, prepared by a mixture of ordinary collodion and castor oil. This collodion film is a specific against hysterical fits, typhoid fever, &c. It must be admitted that the total stopping of all perspiration may be considered as being of some help in different affections. The process may be considered as worth a trial at least, under some peculiar circumstances.—It was stated that the Institute will not interrupt its sittings at any price. If there remains only a single member, that member will sit in order to keep a regular register of communications addressed to the learned company. It is the only means for securing intellectual prosperity of scientific discoveries, and it cannot be stopped even by Communalists. We have no news of the sitting of the 10th.

## BOOKS RECEIVED

ENGLISH.—The Illustrated History of British Butterflies: E. Newman (W. Tweedie).—Select Methods of Chemical Analysis: W. Crookes (Longmans).

AMERICAN.—Medical and Surgical Electricity: G. M. Beard and A. D. Rockwell (New York, W. Wood and Co.).

FOREIGN.—(Through Williams and Norgate)—Die Anwendung des Spectral-apparatus: K. Vierordt.

## PAMPHLETS RECEIVED

ENGLISH.—On the Gibraltar Currents, the Gulf Stream, and the General Oceanic Circulation: Dr. W. B. Carpenter.—Preparatory Programme of the National University for Industrial and Technical Training, and Report of Provisional Committee.—Transactions of the Scottish Arboricultural Society, Vol. vi., part 1.—The Iron and Steel Institute: Address of the President, Mr. H. Bessemer.—The Sicilian Eclipse Expedition: Lecture by Dr. T. E. Thorpe.—Barometer, Manual, Board of Trade: R. H. Scott.—Annual Report of the Manchester Scientific Students' Association for 1870.—Protest against Mr. J. H. Walshs Decision in the Bedford Level Survey: W. Carpenter.—Gas, its high Price in the Metropolis, and the Way to Reduce it: C. G. Cleminshaw.—Explanatory Memoir to accompany sheets 86, 87, 88, and eastern part of 85 of the maps of the Geological Survey of Ireland: G. H. Kinahan and R. G. Symes.—Common Salt, a Remedy against Small-pox.—On the Uniform Flow of a Liquid: Canon Moseley.—On the Mean Thickness of the Sedimentary Rocks of the Globe: James Croll.—The Proceedings of the Cotteswold Naturalists' Field Club for 1869.—On the Post Glacial Deposits of Western Lancashire and Cheshire: C. E. de Rance.—On the Glacial Phenomena of Western Lancashire and Cheshire: C. E. de Rance.—A Lecture on Vegetarianism: Prof. F. W. Newman.—Science Lectures for the People delivered at Hulme Town Hall, second series.

AMERICAN AND COLONIAL.—The Principles of Pure Crystallography: G. Hinrichs.—The Great Pyramid of Jizeh; the Plan and Objects of its Construction.—Monthly Report of the Department of Agriculture for January 1871.—Second Annual Report of the State Board of Health of Massachusetts.—Preliminary Sketch of a Natural Arrangement of the Order Docoglossa: W. H. Dall.—Reports of the Mining Surveyors and Registrars, Victoria, for the quarter ending Dec. 31, 1870.—Digest of the return of all the Deaths from Phthisis in Melbourne and suburbs during 1865-69 and the first half of 1870: W. Thompson.—Government Telegrams and Reports for the benefit of Commerce (Washington).—On the Physical Conditions of a closed Circuit contiguous to a permanent and constant Voltaic Current: A. M. Mayer.—Observations on the Variations of the Magnetic Declination in Connection with the Aurora of October 14, 1870: A. M. Mayer.—On the Temperature and Physical Constitution of the Sun: (from the Journal of the Franklin Institute) Prof. Zöllner.—G. W. Childs: a Biographical Sketch, by James Parton.

FOREIGN.—Die Tangentialwage und ihre Anwendung zur Bestimmung der Dichte fester u. flüssiger Körper mittelst directer Ablesung: K. W. Zenger.—Ueber die Steinsalzablagerung bei Stassfurt: C. Reinwarth.—Zur Erinnerung au Wilhelm Haidinger: F. Ritter v. Hauer.

## DIARY

*THURSDAY*, APRIL 27.

ROYAL SOCIETY, at 8.30.—On the Increase of Electrical Resistance in Conductors with Rise of Temperature, and its application to the measure of Ordinary and Furnace Temperatures; also on a simple Method of Measuring Electrical Resistances: C. W. Siemens, F.R.S.

LONDON INSTITUTION, at 7.30.—On Economic Botany: Prof. Bentley.

ROYAL INSTITUTION, at 3.—On Sound: Prof. Tyndall.

*FRIDAY*, APRIL 28.

QUEKETT MICROSCOPICAL CLUB, at 8.

ROYAL INSTITUTION, at 9.—On the revived Theory of Phlogiston: Prof. Odling, F.R.S.

*SATURDAY*, APRIL 29.

ROYAL SCHOOL OF MINES, at 8.—Geology: Dr. Cobbold.

ZOOLOGICAL SOCIETY, at 1.—Anniversary Meeting.

ROYAL INSTITUTION, at 3.—On the Instruments Used in Modern Astronomy: J. N. Lockyer, F.R.S.

*MONDAY*, MAY 1.

ENTOMOLOGICAL SOCIETY, at 7.

ROYAL INSTITUTION, at 2.—Annual Meeting.

LONDON INSTITUTION, at 4.—On Astronomy: R. A. Procter, F.R.A.S. (Educational Course.)

*TUESDAY*, MAY 2.

ZOOLOGICAL SOCIETY, at 9.—On the Birds of the Island of Celebes: Viscount Walden.—On Speke's Antelope and the allied species of the genus *Tragelaphus*: Sir V. Brooke, Bart.

SOCIETY OF BIBLICAL ARCHÆOLOGY.—On a Hieroglyphic Tablet of Alexander, son of Alexander the Great, recently discovered at Cairo: S. Birch, LL.D., F.S.A.—Some notice of three new bronze Himgaritic Tablets.

ROYAL INSTITUTION, at 3.—On the Geology of Devonshire, especially of the New Red Sandstone System: William Pengelly, F.R.S.

*WEDNESDAY*, MAY 3.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Structure of Lepidopterous Scales as bearing on the Structure of Lepidocyrtus curvicollis: Dr. Maddox.—On the Foot of Dityscus marginalis: B. T. Lowne.

SOCIETY OF ARTS, at 8.—On the Production of Artificial Cold: Prof. J. Gamgee.

*THURSDAY*, MAY 4.

ROYAL SOCIETY, at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30.

LINNEAN SOCIETY, at 8.—The phenomena of Protective Mimicry, and its bearing on the Theory of Natural Selection as illustrated by the Lepidoptera of the British Islands: Raphael Meldola, F.C.S.

CHEMICAL SOCIETY, at 8.—On the Productive Powers of Soils in relation to the Loss of Plant Food by Drainage: Dr. Voelcker, F.R.S.

ROYAL INSTITUTION, at 3.—On Sound: Prof. Tyndall.

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