THURSDAY, APRIL 12, 1883

THE VIVISECTION BILL

THE failure of Mr. Reid's Vivisection Abolition Bill on April 4 affords cause of congratulation to all who are interested in science, although it is perhaps to be regretted that the Bill did not come to a "division" instead of being "talked out." Scientific men must be pleased because one more attempt of ignorance to stop the pursuit of knowledge has been defeated. But, more than this, the failure of the Bill is a boon to all who care for their own health, for that of their families, and for the welfare of society at large. Had it passed it would not only have stopped all experiments in physiology, pathology, and pharmacology in this country, but it would have rendered impossible the detection of crime by the application of physiological tests. Had this Bill been law at the time of the trial of Lamson for poisoning by aconite, his conviction would have been impossible; for although chemical evidence pointed to aconite as the poison used, the tests for it were not sufficiently distinctive to have justified his conviction on chemical evidence alone, and it required to be corroborated by physiological evidence. This was afforded by the injection of the substance obtained from the stomach into some small animals. As these died presenting all the symptoms of aconitine poisoning, the chemical evidence was confirmed, and the poisoner was accordingly convicted.

Under the present law, considerable delay was caused before a certificate could be obtained to allow these experiments to be performed, but if Mr. Reid's Bill had been law, they could not have been performed at all; and secret poisoners secure of immunity might have become as common in this country as they were in the days of the Borgias.

To understand thoroughly the effect of the Bill upon medical science and practice, we must imagine to ourselves what would occur if experiments were stopped not only in this country but in others; for it is not alone in this country that the opponents of vivisection are active; they are endeavouring to stop it as far as they can in America and on the Continent also.

Last week we published some facts and considerations regarding vivisection and its relations to medicine, issued by the Association for the Advancement of Science by Research. The data there contained we should think were sufficient to convince any reasonable person of the advantages that medicine has derived from experiments on animals. But it is curious to notice the way in which they are regarded by anti-vivisectionists. Finding themselves in many cases unable to deny the advantages of the knowledge which has been obtained by experiments, they say this knowledge might have been got without experiments, and so it might, if man had been differently constituted. But being as he is, there is no royal road to knowledge, and he must take the only one which is available for him—that of experiment.

As Mr. Cartwright pointed out in his speech, if experiments on animals are prohibited, experiments must be made on human beings, and in their rudest form. The contrast between such rude popular experiments on man and scientific experiments on animals was illustrated in a speech of Dr. Lyon Playfair in reference to these two kinds of experiments on cholera. The first experiment was tried on 500,000 human beings in London, who were supplied with water contaminated by choleraic discharges with the result that 125 out of every 10,000 consumers died from the effects of the experiment. In two other experiments made by another water company, 180 died in the first experiment, and 130 in the second, out of every 10,000.

These popular experiments on a large scale involved the sacrifice of half-a-million human beings. In contrast with this may be taken the scientific experiments made upon animals by Thiersch and others. These experiments were made on 56 mice, 14 of which died from the choleraic discharges. These were not mixed with water accidentally or carelessly, as in the popular experiment, but were administered under definite conditions, and the effect watched. The results of these experiments showed that water contaminated with choleraic discharges was deadly; the water so contaminated was avoided, and an epidemic was escaped.

The common-sense conclusion on the whole matter was expressed by the Home Secretary, who said that he disliked as much as any man in the House the infliction of pain upon animals, but felt satisfied that under the administration of the law at present there was very little pain inflicted upon animals, and that pain was inflicted under such circumstances as to guarantee that it was not wantonly inflicted, but that it had occurred in the course of experiments that were abundantly justified for the benefit of humanity at large. As a guarantee that no experiments shall be performed that are not abundantly justified, Sir W. Harcourt has made the agreement with the Association for the Advancement of Science by Research, that, "if they will undertake the task of reporting to him upon the experiments, he will undertake that no certificate shall be granted except on a previous recommendation from them." This Association is a representative body of the whole medical profession, being composed of the Presidents of the Royal College of Physicians and Surgeons of London, Edinburgh, and Dublin, of the Royal Society of London, of the Medical Council, and of all the chief medical associations and societies, along with some others specially elected. It would be difficult to imagine a body better adapted for the purposes of maintaining the high character of the profession for humanity, by preventing any wanton infliction of pain upon animals by experiment, whilst at the same time preventing the serious consequences to human health and life which would ensue if properly devised experiments were prohibited by ill-judged and excessive care for animals.

THE BRITISH NAVY

The British Navy: its Strength, Resources, and Administration. By Sir Thomas Brassey, K.C.B., M.P. Vols. I., II., III. (London: Longmans, Green, and Co., 1882.)

THE three volumes of this work already given to the public by Sir Thomas Brassey are to be followed by three others; but as these are to contain reprints of speeches and publications on naval affairs it is preferable to notice separately the first half of the series, which is complete in itself. No better description of the scope and intention of the book can be given than that appearing in the Introduction, where it is described as "a comprehensive summary of all that has hitherto been published, whether in England or abroad, concerning the most important fighting vessels of modern times." It is avowedly a compilation rather than an original work, and Sir Thomas Brassey has rendered a most valuable service to all persons interested in naval affairs by undertaking the very laborious task now completed. He states that it has extended over twelve years, and it must often have seemed as if the end would never be reached in view of the rapid progress being made in naval armaments, and the large number of publications which have appeared in recent years dealing with war-ships, their armour, armament, and equipment. To keep abreast of this progress, and at the same time to retrace the history of war-fleets during the last quarter of a century, must have been a most arduous undertaking, and the author of these bulky volumes must be congratulated on his industry and perseverance. As the result he has produced an unrivalled book of reference, which should be in the hands of all naval officers, ship designers, shipowners, and administrators of naval affairs.

It is a singular fact that until this book appeared English readers had to turn to foreign publications for the best accounts not merely of foreign navies but of the British Navy. There was no English rival to the books produced by Dislére or Marchal in France; by Littrow, Brommy, or Kronenfels in Germany; by Von Tromp in Holland; and by King or Véry in the United States. Scattered notices in the press, meagre Parliamentary papers, the scanty facts respecting H.M. ships given in the Navy List, and the special information afforded by Reports of Commissions or Committees were the best sources of supply open not merely to the general reader but to most naval officers. Sir Edward Reed, in 1869, dealt with the general problems of armoured construction in "Our Ironclad Ships," but the character of that work excluded the detailed descriptions of individual ships and the statistics of various fleets which are most needed in discussions of the relative powers of maritime countries. This want in English literature Sir Thomas Brassey has admirably supplied. His book is better than all its foreign predecessors, and this may be said without offence, seeing that he has been able to draw freely from them, frankly acknowledging his indebtedness. Coming later into the field, he has also been able to add much valuable information not to be found in the earlier books; while in style of production, wealth and beauty of illustration, and moderate price, the "British Navy" stands alone. It is only proper to mention that Sir Thomas Brassey has evidently desired to secure a wide circulation for his book among naval officers, irrespective of the cost of production; and it is to be hoped that his wish will be realised, for it is clearly of the utmost importance that those who have to fight our ships should be well informed as to the characteristics of the ships with which they may be engaged.

Like all compilations this book requires very careful reading. The author gives, in every case, the fullest detail as to the authority from whom he is quoting; but he does not compare or correct various statements on the same subject, or attempt to appraise the relative value of the opinions of the writers from whom he quotes. This is left to the reader. A careless or hasty consultation of the book might therefore lead to wrong conclusions, and a word of warning on this point may not be out of place. For instance, one may find in close succession statements by Admiralty officials, or private shipbuilders who have designed and constructed foreign vessels, or officers of foreign governments—all of which are to be reckoned authoritative—and statements by anonymous or unofficial writers in various publications—some of which, at least, are of doubtful authority. The reader should turn, therefore, in all cases to the admirable "List of Authorities" in order to make sure whose opinions he is studying before adopting them.

Sir Thomas Brassey undoubtedly did wisely in not attempting to reconcile or correct the various statements which he has summarised. Had he done so before accepting office at the Admiralty, the task would have been beyond his power of accomplishment even for the Royal Navy, since it could only be performed by the freest use of official records; and for foreign navies the difficulties would have been obviously greater. As a matter of fact, before the publication of the book took place the author had accepted office as Civil Lord at the Admiralty, and thus had an additional reason for avoiding the difficult task. He is careful to explain that the publication is in no sense an official one, the work having been far advanced before he went to the Admiralty, and having been completed on the lines previously laid down.

This is only one of the many incidental illustrations of the magnitude of the work done, and the difficulty of bringing such a book up to date. For instance, in the second volume, issued in 1882, the author has to explain that the figures given for the naval strengths of various countries date from 1879. Again, the descriptions of progress and experiments in armour and guns, full as they are, necessarily leave unnoticed many important events of recent occurrence which must affect future war-ship construction. Even if a new edition could be produced speedily, and quite up to date, it too would soon need additions.

The author has had many reminders of the fact that although his book is announced as "unofficial," it may be used as an aid to criticism of the action of the Board of Admiralty, of which he is a member. Admiral of the Fleet Sir Thomas Symonds, and other advocates of a more energetic policy in naval affairs, have found many arguments in support of their views in these volumes. Into this controversy we have no intention to enter, but it may be observed that Sir Thomas Brassey, who must be as familiar with the facts as most persons, remarks that, "On a general and dispassionate review of our position, we are led to the conclusion that the naval power of England, in all the vital elements of strength, is greater now than in any former age." This may be true, but Sir Thomas Brassey would also be the first to admit that continued and strenuous efforts are required in order that this position may be maintained.

The first volume is chiefly devoted to armoured ships; a brief description of unarmoured ships being appended. Elaborate tables of the dimensions, speeds, cost, thicknesses of armour, weight of guns, &c., are given for the navies of the world; numberless diagrams and drawings also appear in illustration of distributions of armour, arrangements of armament, character of structural arrangements, design and position of propelling machinery, &c. Besides these there appear a large number of very beautiful woodcuts of typical ships, from designs by the eminent marine artist, the Chevalier de Martino, who was formerly an officer in the Italian Navy, and possesses a seaman's knowledge of ships in addition to his ability as a painter. These diagrams, drawings, and tables taken alone are of the greatest value, and if published separately in a handy form ought to command a large circulation. Sir Thomas Brassey would add to the debt of gratitude we already owe him if he undertook the issue of such a publication, rivalling the French "Carnet de l'Officier de la Marine," or the Austrian "Almanach für die Kriegs Marine."

The second volume deals with "miscellaneous subjects" of great interest and importance. Amongst these are a fuller discussion of unarmoured ships, of torpedoes and torpedo boats, harbour defence and coast defence ships, the employment of mercantile auxiliaries on war services, and many other topics. Amongst these none exceeds in importance the discussion of the possible employment of our merchant steamships in time of war. The means for securing the aid of these vessels when the necessity arises, and of best equipping them, require the gravest consideration. Already something has been done in this direction by the Admiralty, but much more yet remains to be done, if at the time of need the best of our unrivalled merchant ships are to be available for the defence of the mercantile marine or the many other services on which they might be employed.

The third volume is devoted to a summary of opinions on the shipbuilding policy of the Navy. It is in some respects a curious collection, but will well repay a careful study. The classification by the author of this mass of opinions greatly assists the reader. Unanimity on any point is scarcely to be hoped for, and is not to be found; but the reader will find ample suggestion and food for reflection. The advocates of small ships are fully represented; the designers of the *Italia* and *Lepanto* have their views set forth. Those who believe in armour-protection, and those who think it should be abandoned, obtain an equally fair audience. And in these, as in most other matters, the author gives little or no prominence to his own opinions.

Sir Thomas Brassey has given many proofs of his devotion to the naval interests of this country during his Parliamentary career; but by the publication of this work he has established a claim on the gratitude of all classes of English readers who take an interest in naval affairs. W. H. WHITE

OUR BOOK SHELF

Camps in the Rockies. By W. A. Baillie-Grohman. Map and Illustrations. (London: Sampson Low and Co., 1882.)

MR. BAILLIE-GROHMAN has already made himself known as an intrepid hunter, a close observer of nature, and a charming *raconteur*. In the volume before us he shows no falling off in any of these points, and seems quite as much at home among the parks and peaks of the Rocky Mountains as he is among the chamois-haunted precipices of the Tyrol. The present volume is the result of more than one visit, mainly for sporting purposes, to the Far West, between the Yellowstone Park and Utah. Of the wild life of the ranchers and hunters of the region he has much to tell, and many exciting stories of his own hunting experiences. He adds, moreover, not a little to our knowledge of the topography, geology, and natural history of a region, of many parts of which we yet know little. On the Cañons of the Colorado region he has some interesting notes. We shall be pleased to have another such book from Mr. Grohman.

Physics in Pictures: the Principal Natural Phenomena and Appliances Described and Illustrated by Thirty Coloured Plates for Ocular Instruction in Schools and Families. With Explanatory Text Prepared by Theodore Eckardt, and Translated by A. H. Keane, M.A.I. (London: Stanford, 1882.)

THESE plates are somewhat rough and occasionally violent in colouring, but perfectly trustworthy, and well calculated to interest young people and convey to them a clear idea of the elementary scientific truths intended to be illustrated. The accompanying text gives all the explanation necessary. The plates embrace a wide field of subjects in mechanics, navigation, magnetism and electricity, sound, optics, photography, colours, spectroscopy, &c. We hope the collection will find its way into many schools and families.

LETTERS TO THE EDITOR

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

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

Unprecedented Cold in the Riviera—Absence of Sunspots

IN the second week of March Cannes was visited by falls of snow and degrees of cold far exceeding any of which there is previous record. The preceding part of the winter was of average mildness; the minimum thermometer having fallen below freezing only three times, as follows: December 2, 32°; January 24, 29°; January 26, 31·8°. Not once did it fall so low during February; the average minimum being nearly 44°, and the maximum in shade 56°, and was apparently steadily rising with the approach of spring. The following notes are extracted from my diary:—

February 28.—Thermometer, minimum 46°·6, maximum 58°·3;[1] barometer 29·65. Day fine. Wind W., calm. No spot on the sun.

March 1.—Th. min. 48°·3, max. 58°·3; bar. 29·46. Day fine. Wind N.E., moderate.

March 2.—Th. min. 43°, max. 57°·5; bar. 29·42. Fine, with haze. Wind N.N.E., very strong in p.m.

March 3.—Th. min. 42°·8, max. 55°·3; bar. 29·70. Fine, but strong wind from N.E. Not a spot on the sun.

March 4.—Th. min. 36°, max. 54°·8; bar. 29·70. Wind very strong from N.E. Fine, with cumuli.

March 5.—Th. min. 40°, max. 54°·8; bar. 29·70. Cloudy, nimbostratus. Wind very high from N.E.

March 6.—Th. min. 40°, max. 51°·7; bar. 29·40. Fine, but some clouds. Wind N.E., very high and cold.

March 7.—Th. min. 36°·8, max. 53°; bar. 28·87. Snowed in night in large flakes, and till 10 a.m. to depth of 8 inches. Little wind, N.E. The weight of the snow bowed down shrubs and trees, breaking many. In a large shrubbery in my garden, *Erica arborea*, from 10 to 20 feet high, full of flowers,

[1] Thermometers by Casella. Minimum is placed every night outside an east window of the first floor of my villa, the bulb being protected from radiation. Maximum lies shaded inside the same window, open by day. Barometer, aneroid, by Pillischer.

all prostrated. *Mimosæ* of various kinds, also flowering, and the more tender palms, were borne down and broken. Pelargoniums and other succulent shrubs destructively crushed. Partial thaw in the sunshine.

March 8.—Th. min. 27°·7, max. 51°·3; bar. 28·83. Sunshine in morning began a thaw, but only to discover mischief done by the frost. Wind first from N.E.; in p.m. from S.W., increasing thaw.

March 9.—Th. min. 35°, max. 51°; bar. 29·67. Rain in night and most of day, but later turned to snow in large flakes. Wind S.E.

March 10.—Th. min. 27°, max. 44°; bar. 28·88. Fresh snow in night to depth of 4 or 5 inches. Whole country white, including Esterel Mountains, on which snow is hardly ever seen. Wind W., rising, threatening a mistral. Only two small spots on the sun.

March 11.—Th. min. 24°·1, max. 45°; bar. 28·84. Bright morning, but intense cold with mistral, at night destroyed almost all tender plants and shrubs in garden, in spite of covering. One fine young indiarubber-tree of 15 feet, with its rich green and bronze leaves, turned in the night to a spectre of limp black rags. Wind W., calm. Only one small spot on S.E. border of sun.

March 12.—Th. min. 25°·7, max. 49°; bar. 28·90. Sun bright, but hard frost everywhere except in sheltered places. Wind W. strong. Four spots now visible on sun, one larger than the rest, and near it a large oval facula of brighter light.

March 13.—Th. min. 32°·1, max. 49°·6; bar. 29·30. Weather bright, wind W., moderate. Two of the four spots larger, with deeper umbræ; suspicion of a facula near one.

March 14.—Th. min. 29°, max. 54°(?); bar. 29·50. Sky bright, some haze, wind W. Four sunspots, less marked, varying from day to day; one, which was a penumbral streak, now hardly visible.

March 15.—Th. min. 32°, max. 50°·4; bar. 29·30. Weather feels much warmer, wind W.S.W.; one of the sunspots much larger, with a rent of dark umbra within.

March 16.—Th. min. 36°·7, max. 50°·3; bar. 29·19. Weather fine, a little haze, wind W.S.W. Now five spots; two large, with dark irregular centre and fringe of penumbra; two dark, without fringe; one a mere streak of penumbra.

March 17.—Th. min. 41°·9, max. 52°·2; bar. 29·22. Fine in morning, but hazy; later, clouds from S.W. (showing rainband) gathered, and brought first hail, then rain for two or three hours; later, the sun appeared with one of the new spots much enlarged, consisting of a penumbra with two distinct dark clefts within.

March 18.—Th. min. 35°·1, max. 53°·9; bar. 29·48. Bright morning, with haze, wind S.S.W. No change in sunspots.

March 19.—Th. min. 45°·9, max. 52°·5; bar. 29·20. Morning gloomy, with clouds and rain. The wave of cold seems to have passed, but not so the vast deposits of snow left on the mountains behind, and still less the unknown detriment inflicted on vegetable life in the olive and orange groves around us.

The foregoing observations are too few and too imperfect to warrant any decided conclusions, but they add to those already made in evidence of the connection between the absence of sunspots and the diminution of terrestrial heat; and I trust they may be followed by further and more exact investigations to determine the influence of our great luminary on the weather and climate of the world. How far this "cold wave" has extended to other countries and latitudes I am not informed; but it seems to me that their usually cloudless skies bring the shores of the Riviera into closer and more direct relationship with sun-power than other countries, and therefore render them more sensitive to its variations. C. J. B. WILLIAMS

Cannes, March 19

Mr. Grant Allen's Article on "The Shapes of Leaves"

THE article by Mr. Grant Allen on "The Shapes of Leaves," published in NATURE (vol. xxvii. p. 439) as first of a series, calls for an emphatic protest on behalf of botanists, and especially of teachers of botany.

In his introductory paragraphs he at once cuts the Gordian knot of vegetable physiology in a most startling manner. He tells us that "from the free carbon thus obtained [*i.e.* by deoxidation of carbonic acid], together with the hydrogen liberated from the water in the sap, the plant manufactures the hydrocarbons which form the mass of its various tissues." If he had only substituted, by a slip of the pen, the term hydrocarbon for carbohydrate, it might have been regarded as a pardonable piece of negligence; but, since he speaks of "*free carbon*" and *hydrogen*, he shows that he really meant to write the word "hydrocarbons." Naturally he does not bring forward the results of any experiments which may have led him to make this extraordinary statement.

He goes on to say: "Vegetal life in the true or green plants consists merely in such deoxidation of carbonic acid and water, and arrangement of their atoms in new forms." Among other strange conclusions to be drawn from the above lines we see that, according to Mr. Grant Allen, either nitrogen does not enter into the composition of proteids, or that the latter have nothing to do with that "vegetal life" of which he speaks.

Articles containing blunders of such magnitude, but written with that assurance of style which naturally carries conviction to the mind of the unwary, and disseminated through the country in a widely read journal like NATURE, cannot but produce a rich crop of erroneous impressions. These it will be the arduous duty of teachers to eradicate.

Every one will agree that the popular writer must, before all things, be master at least of the first rudiments of the subject on which he writes: Mr. Grant Allen has in two consecutive sentences shown himself singularly deficient in this respect.

It would be premature here to enter upon a detailed criticism of these articles, since the series is not yet complete. But the two sentences I have quoted are so strangely heterodox that they could not be passed over without remark. F. O. BOWER

As I do not think it necessary to preface four short papers on the shapes of leaves with a formal treatise on physiological botany, I am not careful to answer Mr. Bower in this matter. The word hydrocarbons was used deliberately, because the important point to notice is this—that the plant consists in the main of relatively deoxidised materials. From the point of view of energy, with which one has to deal mainly in treating of functions of leaves, that fact is of capital importance. I can conscientiously inform Mr. Bower that I was aware of the chemical constitution of proteids, and of the part which they bear in life generally; but I do not see what harm can be done to anybody by such a confessedly rough statement as that which he criticises. If we must always step aside to say all that we know about any subject whenever we have to deal with it, exposition of new matter becomes impossible. May I call Mr. Bower's attention to the further fact that in the same paper I spoke of the plant catching "fragments of carbon," meaning thereby not free carbon, but carbon in the form of carbonic acid, even though it be merely reduced from carbon dioxide to carbon oxide. It seems to me that such roughly accurate language is permissible in popular writing, where one's main object is to insist only on the general principle involved. It is the carbon that the leaf wants, not the oxygen; it is the carbon and the hydrogen that it deals with, not the nitrogen, which is but the instrument for dealing with them; and the two other elements may therefore be safely neglected. Or must we drag in sulphur, and potassium, and calcium, and all the rest as well? GRANT ALLEN

Ticks

IF W. E. L. will acquaint himself with the somewhat scattered literature of this subject he will find that much useful information has already been placed on record by entomologists and others. The *Farm Journal* for July 10, 1880, contains a sensible and convincing article by Mr. James Elliot, showing the connection between ticks and louping-ill. A good article on the sheep-tick (falsely so called, since it is an insect and not one of the Ixodidæ) occurs in *The Field* for April 26, 1873. The scientific aspects of the subject are well treated of by Mégnin, especially in relation to classification in his "Monographie de la Tribu des Sarcoptides Psoriques," 1877. Mr. Hulme's edition of Moquin-Tandon's "Elements of Medical Zoology" has a useful chapter on ticks (p. 302). Some valuable hints are given in Prof. Verrill's Report on parasites to the Connecticut Board of Agriculture, 1870. An excellent article with good figures on *Melophagus ovinus* appeared in one of the volumes of the *Intellectual Observer*. The ticks of the sheep and stag are both figured in Van Beneden's "Animal Parasites" (English edition of International Series, p. 177). The sheep-tick is likewise figured and described in the "Micrographic Dictionary." References and figures are also given in the standard works of Westwood and Packard on insects. As W. E. L. is probably a practical man, he will do well to consider the proofs afforded by Mr. Elliot that the "ked," as they call it in Scotland, is anything but the harmless insect which some people imagine it to be.

T. SPENCER COBBOLD

I AM inclined to think your correspondent W. E. L., on the subject of "ticks" (p. 531), may have confounded two quite distinct animal forms under that name. The sheep-tick or louse, as shepherds call it, found at the roots of the wool on sheep, and which I have often formerly had brought to me under one of those names, is an aberrant form of *Hippobosca*, a genus of dipterous insects, the typical species being the well-known forest-fly. An excellent figure of the sheep tick will be found in Curtis's "British Entomology," Pl. 142, under the name of *Melophagus ovinus*.

Ixodes is a genus of the Acaridæ, a group easily distinguished from the true insects by their having eight legs in the adult state. Six British species of *Ixodes* are described by Dr. Leach in vol. xi. of the *Linnean Transactions*. There are probably others not as yet determined. The one best known is the common dog-tick, found in a free state in woods and plantations, and attaching itself not merely to dogs but to hares, &c., and especially to hedgehogs, which often abound with them, the ticks getting their hold as the animals pass through the close grass. After attachment they soon get gorged with blood, their abdomens swelling to an immense size compared with the insignificant appearance of them previous to attachment. But I can remember no instance of an Ixodes found on a sheep, though I would not undertake to say they never occur on that animal.

Bath L. BLOMEFIELD

Helix pomatia, L.

I AGREE with Mr. Gwyn Jeffreys (NATURE, p. 511) in considering *Helix pomatia* as indigenous in this country, and not introduced by the Romans. I never found or heard of a single specimen, either living or dead shell, being met with in the neighbourhood of Bath, which the Romans occupied for more than 400 years, though it is found in one or two localities in the adjoining county of Gloucestershire, from whence we have specimens in the museum of the Bath Literary Institution.

Bath L. BLOMEFIELD

Braces or Waistband?

HAVING worn a Spanish sash for some time many years ago while walking in the Pyrenees, I am decidedly of opinion that the weight of the trousers is supported much more easily and pleasantly by a sash than by braces; these last are narrow, about 2 inches wide, and though custom enables us to wear them without conscious inconvenience, I think any one using them for the first time would find them very unpleasant. The sash worn by the middle and lower class in Aragon is of wool 8 or 9 inches broad, and (if my recollection is correct) about 4½ feet long; when of such width and length it does not need to be drawn *tight*, but only closely wrapped round the waist and the end tucked in. I should certainly wear one constantly but that I do not wish to have an eccentric appearance. Medical men, I believe, attach great value to the wearing of sashes or bands round the stomach, especially in hot countries. A narrow silken sash which must be drawn tight is, I should suppose, far less pleasant to wear.

N.

SOLAR RADIATION AND GLACIER MOTION

IN the paper on the "Mechanics of Glaciers," which the author had the honour to read before the Geological Society of London in December last, it is stated that, after all allowance is made for work within the glacier due to the potential energy of the *weight* of the ice-mass, "there remains to be accounted for a *secondary* differential motion, which has, it appears, not yet received a satisfactory explanation . . . the movement is greater (*a*) by day than by night, (*b*) in summer than in winter." The present paper is intended as nothing more than a brief statement of the experimental evidence, upon the strength of which the explanation offered in the paper referred to has been put forward. I may say *en passant* that this investigation was suggested to me by a statement of Dr. Croll's ("Climate and Time," p. 519) that, "We find that the heat applied to one side of a piece of ice will affect the thermal pile on the opposite side." It occurred to me that the looseness of this statement was quite in keeping with the *un*physical notions upon which the writer has built up what he styles his "molecular theory" of glacier motion, and I set to work therefore to investigate its accuracy.

The principal apparatus used consisted of a delicate galvanometer, and a thermopile of a pretty high degree of sensitiveness, made up as it is of eighty-one couples of bismuth and antimony; the measurements were read off numerically by the light reflected on the scale as usual. Suspecting that the fallacy of the statement referred to lay in overlooking the effect of luminous energy, which of course is capable of passing through any *transparent* body, I made a few preliminary trials with glass and water, not having ice then at hand. A beam of solar radiation, having passed through two inches of distilled cold water + half an inch of glass, was allowed to fall upon a Crookes' radiometer; this made the vanes rotate too fast for their rotations to be counted, even when the instrument was enclosed in a wooden case on all sides except that open to the glass-water screen through which the sunshine passed. A beam of solar light, having been sifted of its dark heat-rays in the same manner as before, was received upon the absorbing face of the thermopile, producing a considerable deflection of the magnet in the galvanometer, even with the feeble sunshine of our recent December days.

The next step was a series of trials with *ice* itself. In the first instance, trials were made with the plates of *ice in contact with the metallic face of the pile*, the black (absorbing) face being placed at a distance of 3 inches opposite a large Bunsen flame in a room free froms trong draughts: in this way a constant difference of 36° C. was obtained for the opposite faces of the pile, and maintained for more than half an hour, with the needle of the galvanometer quite stationary. An iron ball 3 inches in diameter, having been heated to dull redness (clearly perceptible in a dark room), was placed opposite the plate of ice (1 inch thick) in contact with the pile, and allowed to cool. It was again heated as before, and placed at a distance of *less than an inch* from the ice (now less than half an inch thick), and allowed to cool. In both cases the effect observed upon the galvanometer was *absolute nil*, even when, in the second trial, the ice had become so thin by melting as to break under the small force required to hold it against the pile.

In the next series of trials the arrangement was reversed, the *ice* being placed just in front of the condensing cone attached to the absorbing face of the pile at a distance of 4 inches; the metallic face of the instrument was maintained at a constant temperature by contact with a vessel of cold water, whose temperature was observed frequently, and found to be practically constant. On the distant side of the ice was placed a double board-screen, with air-space and a circular hole to allow the passage of a cylindrical beam of radiation of the same diameter as the condensing cone. The iron ball, heated to dull red heat as before, was placed opposite the hole of the screen, at a distance of 7½ inches from the face of the pile, the intervening ice-plate in this case being 1 inch thick, and the galvanometer having been stationary for half-an-hour before the experiment was made. Under the same conditions the experiment was repeated (1) with ¼-inch plate of ice; (2) with ¼-inch of pond-ice + wet half-melted snow; (3) with ⅝-inch of fresh-fallen snow. In all these cases the result of the obscure radiation from the ball upon the galvanometer was *absolute nil*, although, without the interposition of ice or snow, the maximum deflection at the end of 5 minutes was 460° on the scale (see accompanying table). This period of time was adopted for this reason, for the duration of each following experiment, though more than needed to produce maximum results. So far the evidence is conclusive that *dark heat* (*i.e.* heat capable of melting ice) applied to one side of a piece of ice does *not* affect the thermopile on the opposite side. So much for the negative results.

It seemed to me at this point worth while to investigate the effects produced by *luminous radiant energy* of various phases of quality after transmission through ice, which, it would appear, effectually barred the passage of all the obscure rays of the iron ball from even entering it, while the liquefaction of the ice at the surface was beyond all comparison greater than that which goes on at the surface of a glacier even with a full midsummer sun. The sources of *luminous energy* chosen are given in the first column of the following table. The feeble effect produced by the blue flame of a very large Bunsen lamp (giving no red, orange, or yellow when examined with the spectroscope) as compared with the effects produced by the more highly luminous gas-flames of far inferior thermal intensity (which gave, of course, a complete visible spectrum), is extremely interesting for the light it throws upon the subject in hand. The table of results explains itself at once to any student of physics. The lime-light used, it may be added, was a very powerful one; the sunshine, however, was not very bright or very constant, owing to the drifting of clouds. The latter fact explains the apparent slight anomaly in the results of the solar radiation given in Series II. and III. The observations were made however with the solar radiation (as estimated by a Crookes' Radiometer) approximately the same for them all.

Table to show the Sifting Power of Ice and Snow upon Radiation of different Phases of Quality

Sources of radiant energy.	*Series I.* Showing relative radiant energy.	*Series II.* With an inch of very clear ice interposed.	*Ser. III.* With ¼ inch of clear ice (with many air bubbles) interposed.	*Ser. IV.* With ¼ inch of pond ice (as in III.) with much wet snow on one side.	*Series V.* ⅝ inch of fresh fallen snow interposed.
1. Red-hot iron ball, 3 inches diameter (at dull red heat) .	460·00	0·00	0·00	0·00	0·00
2. Large Bunsen lamp flame (feeble luminosity) giving incomplete spectrum	135·00	2·00	2·00	0·00	0·00
3. Small Bunsen lamp flame, with air shut off below (giving complete spectrum)	77·00	6·00	4·00	2·00	0·00
4. Small fish-tail gas-burner...	87·00	12·00	7·00	6·00	0·00
5. Lime-light... ...	192·00	51·20	38·40	20·48	0·00
6. The Sun	530·00	310·00	320·00[1]	—	13·00

The numbers in each series in the foregoing table do not give very simple relations among themselves, and each number must be regarded as only a near approximation to the exact truth. Still, when all those slight inaccuracies which arise from "errors of experiment" are allowed for, the general meaning and bearing of the facts remain, namely, that though heat (*quâ* heat capable as it is of melting ice) cannot enter ice, yet *luminous energy, which is readily absorbed and transformed into heat by opaque and semi-opaque bodies*, can enter and pass through the ice, until it meets with a non-transparent body. Substituting for our thermopile in the experiment, stones, dirt, organic germs, &c., within the glacier, we at once perceive how the luminous radiant energy of the sun can (by being transformed into dark heat) play its part in producing the movement of glaciers.

[1] In this case a ½-inch plate of *clear* ice was used.

Further, this will be found, I believe, the *only* satisfactory explanation yet given of the remarkable facts (1) that *glaciers move faster* (in the Alps about twice as fast) *during the summer than during the winter;* (2) *that the motion during the day is greater than during the night.* This fact most people who have written on glaciers have found it difficult to explain, for when the "*Regelation Theory*" is fully accepted, and all that follows from it is recognised, and when due allowance is made for *internal friction*, we still must seek for a cause, independent of both of these, to account for the *variations* in the movements of glaciers, day and night, summer and winter. This cause has now, I think, no longer to be sought for.

The glacier may be compared to a large greenhouse; as luminous energy enters freely through the glass in the one case, so it enters freely through the transparent ice in the other; in both cases, heat available for work is produced by its transformation.

In the glacier this *work* is expended in diminishing the cohesion of the molecules of those parts of the ice which are in contact with the bodies which absorb the luminous energy. The beautiful silvery blue light of an ice-cavern seems to show that a part of a beam of luminous radiation is absorbed by clear ice.

The Series IV. and V. of the table illustrate the effect of (*a*) the more or less granular condition of the ice in many parts of a glacier, (*b*) the snow with which the glaciers are covered during the winter. The diffusive action of the latter upon luminous energy is seen by reference to Series V. to be very great; hence the necessity for the use of coloured spectacles on the higher glacier regions.

A. IRVING

DEDUCTIVE BIOLOGY

IT has probably occurred to a good many readers of NATURE that it would be well if some one were to utter a word of warning as to the mischief which may be done, and especially to students, by the present fashion of explaining all kinds of complicated morphological phenomena in a more or less purely deductive fashion. It is no doubt pleasant, even fascinating, to sit down at one's desk and, having formulated a few fundamental assumptions, to spin out from these explanations of what we see in the world about us. But I think when done it should be understood that the result is merely a literary performance, and though, viewed in that aspect, one may admire the skill and neatness with which it is accomplished, I nevertheless venture to think that the whole proceeding is harmful.

Now, as I shall attempt to illustrate my position by reference to papers which have appeared in NATURE in particular, I may as well say at once that I have no personal or merely controversial object in writing these lines. But though it is now no part of the business of my life to take part in teaching, I have had some experience of it, and a great deal too much of testing its results by the process of examination. I have derived then a tolerably definite idea—as I believe—of the difficulties that beset the imparting of scientific instruction, and a decided conviction as to what sort of discipline is wholesome, and what is mischievous.

Of course I do not deny—far from it—the inspiriting influence which large generalisations impart to teaching. But then I think the intellectual enjoyment of them must be earned. The first thing to do is to put before the student the facts, and then, when these are conscientiously mastered, to show what general conclusions may be drawn from them. The student will thus not merely appreciate the mastery which a comprehensive point of view gives of the subordinate facts, but he will get some insight into the value of the evidence upon which the induction rests, and be quite prepared to understand that in the face of a wider survey of observations it may have to be materially modified. This method of procedure seems to me to be not only the scientifically sound one, but to have an educational value of a very high order.

The opposite method is to start with the general principles and derive the explanations from them. This no doubt affords play for ingenuity. But the intellectual discipline is immensely inferior. And when the elaborate structure is built up, it is impossible not to begin insensibly to resent with jealousy any criticism of its foundations, even when it has become difficult to resist the suspicion that they are decrepit. This state of things might be illustrated from the history of the biological sciences again and again. Generalisations which at first were justly hailed with enthusiasm have finally become mischievous obstructions in the way of their adherents arriving at a better knowledge.

I do not mean to say that I prophesy this fate for the evolution theory. But I confess I look with great dislike on the growing tendency, especially in writings intended for popular consumption, to explain everything by it deductively. We may think the probability of organic forms having been evolved is very great. But the *how* of the process is what in every case we have to prove. In this way the induction on which the theory of evolution rests perpetually widens its base, while at the same time our detailed knowledge of the subordinate laws through which it acts continually accumulates. But if, assuming the truth of the evolution theory, we proceed to spin out of our heads an explanation of how any particular phenomenon came about, I fail to see in what way we are the wiser. The theory of evolution runs a very good chance of being burlesqued; and at the best we find ourselves in possession not of a new knowledge, but merely of an ingenious literary exercise.

In several successive articles, a very able writer, Mr. Grant Allen, has discussed and given a deductive explanation of the shape of leaves. Now this is a matter on which a good many botanists have probably bestowed much thought, and it is well known to be beset with immense difficulties. I believe I am justified in saying that for the last ten years of his life it constantly engaged the attention of Mr. Darwin, and it cannot be doubted that if the problem had at all readily admitted of solution he would have at any rate made some attempt to do for leaves what he did for flowers. In work of this kind Mr. Darwin assumed nothing. His method was purely inductive. He made an immense number of observations drawn from the most widely severed types existing under the most varied conditions, and he gradually felt his way towards some general conclusions. But the fact is that the form of leaves, in common with a great deal of external morphology, is a product of a complex of conditions. Whatever general principles control it, we may be pretty sure that they do not lie on the surface. It is sufficient to mention a few of the obvious factors that must enter into the solution to see that this must be true. In the first place we have the conditions of development; a leaf which, like that of the wild hyacinth, has to be pushed up through compressed soil, must be shaped accordingly, and differently from one, such as that of a horse-chestnut, which languidly expands, like the wings of a butterfly newly escaped from its chrysalis, into the unresisting air. Then we have mechanical conditions; a leaf is a much greater feat of natural engineering than a stem; a fragile expanded structure has to be carried on a single support and supplied with a framework which must have the necessary rigidity not to collapse, and at the same time be carefully adjusted to withstand wind-strains. Then it must be adapted to meteoric conditions; it must be capable of withstanding solar radiation without being scorched, and its own reduction of temperature at night without being irremediably frozen. With this last circumstance is probably correlated the great variety of nyctitropic movements which leaves execute, and these again react on their form and construction. The enumeration might be very much prolonged; this is only a sample. But it will suggest to most people, as I imagine it did to Mr. Darwin, that, before asserting anything definite about the laws that govern the form of leaves in general, there is an enormous amount to be made out about their relation to particular circumstances of the environment.

But, as far as I can make out, all these considerations count as nothing with Mr. Grant Allen. "Two points," he says, "between them mainly govern the shapes of leaves." One of these is the relation of the leaf to sunlight: and the importance of this no one doubts. The other is the tendency of the plant "to have its whole absorbent surface disposed in the most advantageous position for drinking in such particles of carbonic acid as may pass its way." The importance of this, Mr. Grant Allen adds, "appears hitherto to have been too frequently overlooked."

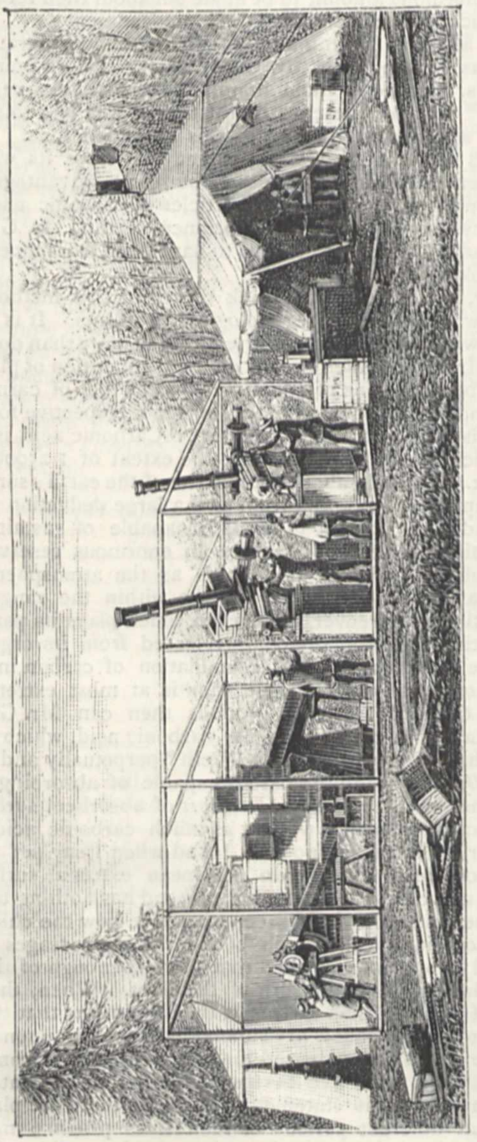
Now, as I have said, I think the deductive method is a bad way of solving morphological problems. It is still worse when the principle started from is more than doubtful. Mr. Grant Allen speaks of the competition of plants for carbonic acid as of the same kind as that of carnivorous and herbivorous animals for their respective foods. But it is surely nothing of the sort. Carbonic acid is an ingredient of the atmosphere to the extent of 1-2500th of its bulk. But only about one-quarter of the earth's surface is occupied by land, and from this a large deduction may be made on account of areas incapable of sustaining vegetation. There is therefore an enormous reserve of atmospheric carbonic acid which, as the atmosphere is rarely at rest, is constantly brought within the range of vegetation. Moreover, the carbon which plays its part in vegetation is continually being released from its organic trammels and the secular accumulation of carbon in the soil, though the work of vegetation is at most extremely slow. On what possible grounds then can Mr. Grant Allen talk of a competition for carbonic acid, which the wind that "bloweth where it listeth" perpetually and *impartially* supplies to the tissues capable of absorbing it? It cannot be doubted that, *per unit* of absorbent surface, one plant in a locality will get as much carbonic acid as another, no more and no less. And when I say per unit of absorbent surface, I do not mean external surface, which, as well as the shape, I apprehend has nothing to do with the matter. It is of no consequence how the chlorophyll-containing cells which bound the air-passages are massed into a leaf, provided that there is enough of them to do the carbon-fixing work of the plant. When, therefore, Mr. Grant Allen arrives at the conclusion that "the extent to which leaflets are subdivided depends upon the relative paucity of carbon in their environment," I confess that I should much like to see the experimental data, if any, on which this statement rests. As there are plants which at different periods of their lives produce much and little divided leaves, the point would possibly admit of being actually tested.

Now with regard to the submerged foliage of water-plants, I am free to admit that I think Mr. Grant Allen has made a point. These must absorb their carbonic acid superficially, being destitute of stomata and intercellular passages. But I do not see why he should say that the proportion of carbonic acid held in solution by water is very small. It is, I believe, never less than the proportion that occurs in the atmosphere, and may rise to nearly one per cent.

W. T. THISELTON DYER

THE APPROACHING ECLIPSE

THE accompanying illustration from *La Nature* shows the instruments to be used at the total eclipse of May 6, by M. Janssen, who has command of the French expedition. The illustration is after a photograph taken at M. Janssen's Observatory at Meudon. The French expedition, which has probably reached its destination, will be located on Sable Island, near Caroline Island, in the Marquesas Archipelago. Before quitting Paris, M. Janssen had all his instruments and tents erected in order to see that all worked well. The frame surrounding the



Apparatus for French Eclipse Expedition.

apparatus is arranged to receive a large awning to protect them. The tent on the right is intended for the astronomers, the furniture consisting of a work-table, several camp-stools, and three beds. The little tent on the left is for photography. The instruments of the French expedition comprise—1. A telescope of short focus for spectroscopic work. 2. An equatorial on which will be arranged a photographic apparatus, containing five cameras which act together. The plates are $0^{m}\cdot40$ by $0^{m}\cdot50$; they will require an exposure of five minutes. This apparatus is intended for intra-Mercurial planets. 3. A telescope of 6 inches, with a lens of 3 inches, with photographic apparatus acting by means of three cameras at once. This apparatus is intended for the solar corona. 4. A fourth telescope, specially reserved for M. Trouvelot for drawings of the corona and search for intra-Mercurial planets.

DEATHS FROM SNAKE BITE IN BOMBAY

THE Report of the Sanitary Commissioner with the Government of Bombay shows that, among other causes of death in that Presidency in the year 1881, 1209 persons died from snake bite. The names of the snakes are not given, but it is probable that the cobra was the chief offender, the echis and bungarus accounting for those not slain by that snake. The monthly prevalence of deaths from this cause is interesting, as it shows at what period of the year efforts for destruction of snakes might be most effectively carried on; it also shows that there was an increase of thirty deaths on those of the preceding year; and it suggests that, however vigorous these efforts may have been, the result is not so satisfactory as could be wished, as a comparison of the deaths in 1881 with the mean of those of five preceding years shows that (in 1881 at least) the number had increased.

Months.	Deaths in 1881.	Mean of five years.
January	39	30
February	34	24
March...	55	45
April	55	49
May	95	93
June	162	135
July	191	164
August	165	159
September	161	160
October	128	144
November	80	68
December	44	39
	1209	1110

This (in 1881) proves that one person in 13,610 of the whole population of 16,450,414 for the twenty-four Presidency districts died from snake bite. June, July, August, September, and October are the months of greatest mortality, and it would be worth while inquiring if more vigorous efforts could not be made for the destruction of the snakes during these months, when it is presumed the creatures are more numerous and perhaps more active in their destructive work. The appearance and character of venomous as distinguished from harmless snakes ought now to be so well known in India that, whatever other difficulty may stand in the way of their destruction, absence of means of identification should not be one of the obstacles.

After all the mortality from snake bite is very small compared with that from other causes. The same able and most valuable Report shows that in the year 1881 there were 272,403 deaths from fever, of which no doubt a large proportion were due to miasmatic causes. The entire death-rate from all causes amounts to 381,450, or 23·18 per 1000 of the whole population. Against these death-rates and their preventable causes, whether from dirt, miasmata, foul water, or snake virus, the earnest endeavours of the sanitary authorities are now unremittingly directed, and it is impossible to read the Reports annually prepared by the Sanitary Commissioners without feeling impressed by their value and importance, or without a conviction that they must sooner or later have beneficial results on public health and the value of life in India.

JOSEPH FAYRER

ASTRONOMICAL PHOTOGRAPHY

THE important part that photography is likely to play in the future of astronomy renders it desirable that an opportunity should be afforded to astronomers to acquaint themselves with the improvements continually made in this branch of their science. This could best be done by the establishment at convenient places of collections designed to exhibit the progress of photography as applied to astronomical observations.

The Harvard College Observatory has some special advantages for forming such a collection, since it already possesses many of the early and historically important specimens which would naturally form part of the series. Among these may be mentioned four series of daguerreotypes and photographs of various celestial objects taken at this Observatory. These series were respectively undertaken in 1850, 1857, 1869, and 1882.

At present, the astronomers of the United States have no ready means of comparing their own photographic work with that done in Europe, or even with that of their own countrymen. The proposed collection of photographs, so far as it could be rendered complete, would greatly reduce the difficulty.

It is therefore desired to form, at the Harvard College Observatory, a collection of all photographs of the heavenly bodies and of their spectra which can be obtained for the purpose; and it is hoped that both European and American astronomers will contribute specimens to this collection. Original negatives would be particularly valuable. It may happen that some such negatives, having slight imperfections which would limit their value for purposes of engraving, could be spared for a collection, and would be as important (considered as astronomical observations) as others photographically more perfect. In some cases, astronomers may be willing to deposit negatives taken for a special purpose, and no longer required for study, in a collection where they would retain a permanent value as parts of an historical series. Where photography is regularly employed in a continuous series of observations, it is obvious that specimen negatives only can be spared for a collection. But in such cases it is hoped that some duplicates may be available, and that occasional negatives may hereafter be taken for the purpose of being added to the collection, to exhibit recent improvements or striking phenomena.

When negatives cannot be furnished, glass positives, taken if possible by direct printing, would be very useful. If these also are not procurable, photographic prints or engravings would be desirable.

In connection with the photographs themselves, copies of memoirs or communications relating to the specimens sent, or to the general subject of astronomical photography, would form an interesting supplement to the collection. A part of the contemplated scheme will involve the preparation of a complete bibliography of the subject, including a list of unpublished photographs not hitherto mentioned in works to which reference may be made.

The expense which may be incurred by contributors to the collection in the preparation and transmission of specimens will be gladly repaid by the Harvard College Observatory when desired.

EDWARD C. PICKERING,
Director of the Harvard College Observatory

Cambridge, Mass., February 21

DARWIN AND COPERNICUS[1]

THE losses by death which natural science has sustained during the past year are unusually heavy. The fertile and ingenious mathematician who for more than a generation held a leading position among French men of science as the publisher of one of the best-known mathematical journals; the chemist who, by the first organic synthesis, helped to dispel the illusion of vital energy; the physiologist who solved one of the oldest problems of humanity—are men whose death leaves a void not easily filled up. But the lustre of even such names as Liouville, Wöhler, and Bischoff pales before that of the first on our list, Charles Darwin. Nearly every learned Society in existence has publicly deplored his loss. As this Academy has not hitherto found a fitting opportunity for doing so, it is necessary to add a few words to the formal mention of his decease, to show that we also appreciate the greatness of the man and of the loss science has sustained in him.

To say anything fresh concerning him will only be possible when the lapse of time and the progress of science have opened up new points of view; and the speaker, who has often had occasion to discuss Darwin before this Academy, finds it especially difficult not to repeat himself, the more so as opinions of his work are still somewhat apt to be influenced by personal feeling.

Darwin seems to me to be the Copernicus of the organic world. In the sixteenth century Copernicus put an end to the anthropocentric theory by doing away with the Ptolemaic spheres and bringing our earth down to the rank of an insignificant planet. At the same time he proved the non-existence of the so-called empyrean, the supposed abode of the heavenly hosts, beyond the seventh sphere, although Giordano Bruno was the first who actually drew the inference.

Man, however, still stood apart from the rest of animated beings—not at the top of the scale, his proper place, but quite away, as a being absolutely incommensurable with them. One hundred years later Descartes still held that man alone had a soul and that beasts were mere automata. Notwithstanding all the labour of naturalists since the days of Linnæus, notwithstanding the resurrection of vanished genera and species by Cuvier, the theory of the origin and interdependence of living things, which was almost universal five-and-twenty years ago, was only equalled in arbitrariness, artificiality, and absurdity by the celebrated theory of Epicycles, which caused Alfonso of Castile to exclaim, "If God had asked my advice when he created the world, I should have managed things much better."

"Afflavit Darwinius et dissipata est," would, alluding to the above-mentioned theory, be a fitting inscription for a medal in honour of the "Origin of Species." For now all things were seen to be due to the quiet development of a few simple germs; graduated days of creation gave place to one day on which matter in motion was created; and organic suitability was replaced by a mechanical process, for as such we may look on natural selection, and now for the first time man took his proper place at the head of his brethren.

We may compare Copernicus's student days at Bologna with Darwin's voyage in the *Beagle*, and his retired life at Frauenburg with Darwin's in his Kentish home, up to the time when the appearance of Mr. Wallace's work caused him to break his long silence. Here happily for Darwin the parallel ends. Many circumstances combined in Darwin's case to render his task easier and insure his ultimate triumph. Botany and zoology, morphology, the theory of evolution, and the study of the geographical distribution of plants and animals, had advanced far enough to allow of general conclusions being drawn from them; Lyell's sound sense had freed geology from the hypotheses which disfigured it, and introduced the idea of uniformity into science. The doctrine of the conservation of energy had been put on a new basis, and extended so that in combination with astronomical observation it gave rise to entirely new views of the history and duration of the universe. The doctrine of vital energy had been proved to be untenable on closer investigation. An unusually dry season had some years earlier led to the discovery of the so-called lake-dwellings in the bed of one of the

[1] Address by Prof. E. Du Bois Reymond at the anniversary meeting of the Berlin Academy of Sciences.

Swiss lakes, whereby prehistoric research was quickly extended and developed. Though many links are still missing, we may fairly consider the knowledge of the existence of primeval man as the beginning of the long-looked for connection between him and the anthropoids on the one hand, and between them both and their common progenitors on the other. In a word the time had come for the publication of the "Descent of Man"; that is why an opinion on the nature of man, which differs from all former ones fully as much as the system of Copernicus, of which it is the complement, differs from that of Ptolemy, found such ready and general acceptance.

How different was the fate of Copernicus! "Copernicus," says Poggendorff, "is, and will ever remain, a brilliant star in the firmament of science; but he rose at a time when the horizon was almost entirely obscured by the mists of ignorance. . . . The Ptolemaic system was too ancient and too much venerated to be easily displaced." Copernicus's teaching met with but scant appreciation for the first fifty years after its publication; even Tycho Brahe opposed it; it can therefore scarcely cause surprise that Luther rejected it, that Giordano Bruno died at the stake for his advocacy of it, while the less steadfast Galileo was forced to renounce it.

Notwithstanding the pessimism of our speculative philosophers, who deny all progress because they contribute nothing towards it, Darwin's lot was happier than that of the great reformer of astronomy. While Copernicus could only feast his eyes on the first printed copy of his work as he lay on his deathbed because he had not dared to publish it sooner, although he had completed it some years before, Darwin survived the appearance of his nearly a quarter of a century. He witnessed the fierce struggles its appearance at first gave rise to; its ever increasing acceptance and its final triumph, to which he, cheerful and active to the last, greatly contributed by a long series of admirable works.

While the Holy Inquisition persecuted the followers of Copernicus with fire and sword, Charles Darwin lies buried in Westminster Abbey among his peers, Newton and Faraday.

SINGING, SPEAKING, AND STAMMERING[1]

III.—Stammering

After the emotional and intellectual sides of human utterance, what may be termed its pathological aspect was considered. Imperfections of speech, though serious hindrances to intercourse, are unfortunately not uncommon. It is not easy to realise how common they are. The statistics collected by Colombat point to the conclusion that about two persons in every thousand stammer, an estimate which is exactly borne out by official returns obtained in Prussia. This would make two and a half millions of stammerers in the world. But it is hardly fair to argue from the higher to the lower races of mankind, for stammering, like hysteria, is undoubtedly a disease of advanced civilisation. It was unknown among the North American Indians in Catlin's time; Livingstone says he never met with a case among the Negroes, and Cameron is stated to have confirmed the observation. It is uncommon in Spain and Italy, but reaches its maximum in highly-educated Prussia and in this country. "No nation in the civilised world," says Mr. Deacon, who has been already quoted, "speaks its language so abominably as the English."

Stammering appears to be commoner among males than females.

Laboured distinctions have been made between the two words, to stammer and to stutter, by which the infirmity is denoted. These seem to be wholly unnecessary, since they are practically synonymous. Both words contain an imitation of the defect itself. They probably reach us through the German language, but the ultimate root is the Greek Στείβω, and the fundamental meaning movement abruptly checked. There is indeed a whole series of allied old English words such as lag, dag, jog, shog, stag, and cognates are stab, stagger, stamp. In some parts of the country a horse is said to stammer when he trips in walking. Bacon, in his "Natural and Experimental History," says: "Many stutters are very cholerick, choler inducing dryness of the tongue." It was long ago noticed by Sir Charles Bell in his Bridgwater Treatise, that speech, like writing, walking, and other functions of life, is a coordinate muscular act involving many nerves as well as muscles, but which, having been learned early, has become so automatic that the directing of special attention to it rather hinders than assists in its easy performance. Indeed the act not only involves the mechanism of speech proper, but also that of thought and ideation, as well as that of hearing, by means of which the sounds emitted are discriminated. It thus may never be developed, as in idiocy, of which the failure to acquire it is often the first sign: or in congenital deafness, which is the precursor of dumbness. It may also disappear entirely or partially in conditions of cerebral lesion known to medical men under the titles of aphasia, aphemia, and amnesia, often accompanying hemiplegia of the right side of the body. Real stammering may be produced by mental strain or shock, and persist through life. Such cases are rare, but the lecturer has been allowed to refer in general terms to one which can easily be verified—that of a clergyman who, after being overtaxed physically and mentally during one of the earlier cholera epidemics, began to stammer, and though now an old man, has never since been able to officiate in the service of the Church. Mr. Plumptre, in his lectures on Elocution, quotes even a more remarkable case from Dr. Mariano Semmola, where the loss of articulation was accompanied by convulsive movements, and instantly restored by bleeding.

The failure of coordination requisite to accomplish so complex a function may occur anywhere in the apparatus involved. Hence there are many forms of the affection, which may be roughly classified into four: (1) at the glottis, (2) at the isthmus of the fauces, (3) between the tongue and palate, (4) at the lips and posterior nares. The late Charles Kingsley, in his article quaintly named "The Irrationale of Speech," published in *Fraser's Magazine* for July, 1859, calls these four variations abuses of breath, jaw, tongue, and lips. But these by no means exhaust the catalogue of physical infirmities affecting speech, though being the most completely functional they fall strictly within the definition of stammering. Idiocy, deafness, and paralysis have been named, and to them may be added spasm, as in some cases of St. Vitus's dance. There are also several malformations and acquired disorders, such as (1) large or unsymmetrical tongue or tonsils, (2) cleft palate, (3) obstructed nasal passages, (4) high roofed mouth, (5) prominent and everted incisor teeth, which interfere with distinct articulation; besides the kindred bad habits called lisping, burring, and thickness of speech. Even then the list is not completed; for we have to add (1) a sort of hyperæsthesia or nervousness which occurs in some persons when they are out of health, and which disappears under better hygienic conditions; (2) tricks and bad habits, of which a flagrant example occurred some years ago, when a mania for transposition of words seized the younger and more thoughtless of the generation. A mutton chop, for instance, became a chutton mop, and one heard of the Chishop of Bicester, who had a sit of fickness through eating acon and beggs. In many cases the habit became uncontrollable, and is handed down to fame by the lady aunt of "Happy Thoughts," in *Punch*, who corrected errors of speech by reference to "Dixon's Johnsonary." (3) Mimicry, which produces a sort of contagiousness in

[1] Abstract by the Author of three Lectures at the Royal Institution, by W. H. Stone M.B., F.R.C.P. Concluded from p. 533.

mispronunciation. An instance of this occurred within the lecturer's experience at Marlborough School not long ago: one stammering member of a certain form having communicated his defect to several of his schoolfellows. (4.) Bad teaching, and inattention to faults in their nascent condition. Many mothers think fit to accommodate their speech to favourite children by mutilating and defacing it; keeping two vocabularies, one for the drawing-room, another for the nursery. This is a fatal source of imperfections, the more so as it is to be remarked that stammering never comes on till about the age of five years or more.

Lastly come peculiarities of an unconscious character akin to stammering—clucking, coughing, the reiterated interpolation of otiose syllables such as "er er," "ta ta"; even of definite words or sentences such as "you know," or the coarse expletive adjectives of habitual swearers. The lecturer cited a case within his own remembrance where an estimable clergyman had acquired the singular trick of unconsciously interlarding all his remarks with the involuntary phrase, "What a pity! what a pity!" in defiance of all sense and context.

Methods of cure were then adverted to. Probably no human infirmity had been the object of such diverse or such blundering and unscientific treatment. Even so good a surgeon as Diefenbach cut wedges out of the tongue of the patient; Itard made them speak holding a gold fork in their mouth; Serres advised a waving motion of the arms during speech; Bertrand caused them to regulate the words to a rhythmical motion of the fingers, or to keep time to a stick as in the orchestra. He also placed substances in the mouth. This had been done centuries before by Demosthenes, according to that unveracious gossip, Plutarch. These might be termed mechanical attempts at cure.

Next to them came musical methods, and foremost among them singing; it being well known that many confirmed stammerers sing with perfect articulation. Secondly, a so-called secret method, which consisted in either whispering or speaking in a gruff unmelodious tone. Thirdly, the very opposite of this as recommended by Marshall Hall, namely, chanting or monotoning. Fourthly, preceding all abrupt and consonantal sounds by a vowel such as E, recommended by Arnott. Fifthly, the plan of running all the words of a long sentence into one, and thus acquiring as it were an articulatory momentum.

Intellectual or rational methods brought the lecture to a close. First among these is pausing and deliberateness. The stammerer may be compared mechanically to a steamship which overruns her screw, and treated similarly. Secondly, the imitation of good models, by reading in unison with an articulate speaker. Thirdly, and perhaps best of all, prefacing every sentence by a deep breath, which relaxes all the muscles of speech, and enables them to start fairly one against another. Fourthly, a plan was suggested which had succeeded admirably in the lecturer's experience, namely, that of learning a new language. For this purpose none was better than French. Its pronunciation is so thoroughly different from that of English, that it requires and establishes a totally new coordination of muscles. Moreover its mode of habitual acquirement is entirely different from that of English. Any one who will watch a French child just rising out of infancy must notice that whereas the character of an English child's incipient speech is "smudging" and confusion, the other's is slow, pompous, and deliberate. It is not till later in life that the French acquire that lightning-like rapidity of speech which is the terror of foreigners; while young they speak well and slowly. The third lecture ended with a few directions how to proceed in a case of stammering, and some suggestions as to the prospects of cure. As to the former, it is obviously desirable to examine carefully for the exact seat and the exciting cause of the defect; most of the systems in vogue having erred by exaggerating a particular treatment to the exclusion of others equally admissible. As to the latter, there is no doubt that stammering can be cured. This was proved by such instances as Demosthenes, Wilberforce, and Kingsley. But it was equally proved by the three names thus enumerated that to conquer the vicious habit required no usual amount of patience, ability, and determination.

DISTRIBUTION OF ENERGY IN THE SPECTRUM

IN the reaction against the arbitrariness of prismatic spectra there seems to be danger that the claim to ascendency of the so-called diffraction spectrum may be overrated. On this system the rays are spaced so that equal intervals correspond to equal differences of wave-length, and the arrangement possesses indisputably the advantage that it is independent of the properties of any kind of matter. This advantage, however, would not be lost, if ins ead of the simple wave-length we substituted any function thereof; and the question presents itself whether there is any reason for preferring one form of the function to another.

On behalf of the simple wave-length, it may be said that this is the quantity with which measurements by a grating are immediately concerned, and that a spectrum drawn upon this plan represents the results of experiment in the simplest and most direct manner. But it does not follow that this arrangement is the most instructive.

Some years ago Mr. Stoney proposed that spectra should be drawn so that equal intervals correspond to equal differences in the *frequency of vibration*. On the supposition that the velocity of light in vacuum is the same for all rays, this is equivalent to taking as abscissa the *reciprocal* of the wave-length instead of the wave-length itself. A spectrum drawn upon this plan has as much (if not more) claim to the title of *normal*, as the usual diffraction spectrum.

The choice that we make in this matter has an important influence upon the curve which represents the distribution of energy in the spectrum. In all cases the intensity of the radiation belonging to a given range of the spectrum is represented by the area included between the ordinates which correspond to the limiting rays, but the form of the curve depends upon what function of the ray we elect to take as abscissa. Thus in the ordinary prismatic spectrum of the sun, the curve culminates in the ultra-red, but in the diffraction spectrum the maximum is in the yellow, or even in the green, according to the recent important observations of Prof. Langley. If we wish to change the function of the ray represented by the abscissa, we can of course deduce by calculation the transformed curve of energy without fresh experiments. To pass from the curve with abscissæ proportional to wave-length to one with abscissæ proportional to reciprocals of wave-length, we must magnify the ordinates of the former in the ratio of the square of the wave-length, and this will give us an energy curve more like that obtained with a prismatic spectrum.

There is another method of representation intermediate between these two, which is not without advantage. In the diffraction spectrum the space devoted to a lower octave (if we may borrow the language of acoustics) is greater than that devoted to a higher octave. In Mr. Stoney's map the opposite is the case. If we take the *logarithm* of the wave-length (or of the frequency) as abscissa, we shall obtain a map in which every octave occupies the same space, and this perhaps gives a fairer representation than either of the others. To deduce the curve of energy from that appropriate to the diffraction spectrum, we should have to magnify the ordinates in the ratio of the first power of the wave-length.

My object, however, is not so much to advocate any particular method of representation, as to point out that the curve of energy of the diffraction spectrum has no special claim to the title of "normal."

RAYLEIGH

THE ORNITHOLOGIST IN SIBERIA[1]

THE ornithologists are certainly among the most enterprising of the seekers after truth. John Gould, the Birdman, is dead, but the same spirit which led him over the seas fifty years ago to investigate the then unknown Ornis of Australia still animates his brother birdmen. Mr. Henry Seebohm—a distinguished Member of the British Ornithologists' Union—has recently made two journeys into Northern Siberia, solely with the object of observing new forms and habits of bird-life and of collecting specimens. The scientific results of these expeditions have been published in the *Ibis*—the organ of the British Ornithologists' Union—which is now entering upon the twenty-fifth year of its existence, whilst a most interesting and attractive general narrative of the two journeys is given in the volumes now before us.

FIG. 1.—Grey Plover's nest and young.

The first of these two expeditions, to the lower valley of the Petchora, in North-Eastern Russia, was made by the author in 1875, in company with Mr. J. A. Harvie-Brown, a gentleman whose name is also known as that of an excellent field-naturalist. In order to be in time for the early spring migration, London was quitted on March 8, and the railway taken *viâ* St. Petersburg and Moscow to Vologda. Hence it was rather more than four days and nights continuous sledging to Archangel, which was reached on March 18 at noon. At Archangel, the last civilised city on the route, nineteen days were spent in completing preparations for the further journey and in collecting information of what was considered by the good citizens of that place to be a most formidable undertaking. From Archangel to Ust-Zylma, on the Petchora, a distance of from seven to eight hundred miles lay before the travellers, and as the frost showed some symptoms of breaking up, did not at first promise to be easily got over. Fortunately they were just in time. A fortnight later the thawing snow became impassable, the winter road was destroyed, and the valley of the Petchora became cut off from all communication with civilised Europe for two months! Ust-Zylma, a long, straggling village of wooden houses on the right bank of the Petchora, some 300 miles from its mouth, was the headquarters of the party until June 15. The waiting for the "coming of spring" was rather tedious. Their first week at Ust-Zylma was not very encouraging from an ornithological point of view. After eight days' work, the list of identified birds in the valley of the Petchora only amounted to nine species, mostly of the commonest description. Three weeks had passed, and the thaw still made no progress; the summer seemed as far off as ever. It was sometimes hot in the daytime, but always froze again at night. On April 28 the first bird's-nest was taken (that of the Siberian Jay), but snow-shoes were still required to get about. It was not until May 10, in fact, that any real summer weather came, and it thawed in the shade as well as in the sun; but two days later it actually rained. The migrants then arrived in quick succession: swallows, swans, geese, gulls, wagtails, redstarts, pipits, and shorelarks, all were hurrying up from the south along with the first blush of spring. On May 20, while the party were on a collecting expedition on the opposite bank of the Petchora, which they had crossed as usual on sledges, the grand crash came. The ice which had so long covered the river began to break up with a noise as of rumbling thunder, and cracks ran along it at the rate of a hundred miles in twenty-four hours. It was with great difficulty that the retreat was effected, and a few hours after home was reached the mighty river was in full flood, carrying its burden of pack-ice and ice-floes to the sea at the rate of six miles an hour. In a week's time the Petchora was entirely free from ice, and summer was upon them.

Collecting now began in earnest, and every day added to the number of interesting birds, and increased the variety of nests and eggs. On June 8, 143 eggs were taken and "blown" in the course of the day.

On June 10 the journey down the Petchora was commenced in a large, partly-covered boat hired for the purpose, so that the naturalists might stop when they pleased for the purpose of collecting. The voyage was delightful. Everywhere the Blue-throat, the Redwing, the Brambling, the Fieldfare, the Little Bunting, and the Willow-warbler were common, whilst Three-toed Woodpeckers, Terek Sandpipers, and other rarities were making their nests and laying their eggs for the benefit of the travellers. Here one of the great discoveries of the expedition was made, which cannot be described better than in Mr. Seebohm's own words:—

"We were now a little to the north of the Arctic circle, and at three in the morning moored our boat on the

[1] "Siberia in Europe: a Visit to the Valley of the Petchora, in North-East Russia; with Descriptions of the Natural History, Migration of Birds, &c." By Henry Seebohm, F.L.S., F.Z.S. 8vo. (London: Murray, 1880.)
"Siberia in Asia: a Visit to the Valley of the Yenesay, in East Siberia; with Descriptions of the Natural History, Migration of Birds, &c." By Henry Seebohm. 8vo. (London: Murray, 1882.)

shores of an island, among whose willows grew an occasional birch or alder. I spent five hours upon it. Sedge-warblers were singing lustily, and sometimes so melodiously that we almost took them to be Blue-throats. Soon, however, my attention was arrested by a song with which I was not familiar. It came from a bird singing high in the air, like a lark. I spent an hour watching it. Once it remained up in the sky nearly half an hour. The first part of the song was like the trill of a Temmick's stint, or like the concluding notes of the Wood-warbler's song. This was succeeded by a low guttural warble resembling that which the Blue-throat sometimes makes. The bird sang while hovering; it afterwards alighted on a tree, and then descended to the ground, still continuing to sing. I shot one, and my companion an hour after shot another. Both birds proved to be males, and quite distinct from any species with which either of us was previously acquainted. The long hind-claw was like that of the Meadow-pipit, and the general character of the bird resembled a large and brilliantly-coloured Tree-pipit. It was very aquatic in its habits, frequenting the most marshy ground amongst the willows.

"On our return home five skins of this bird were submitted to our friend Mr. Dresser, who pronounced it to be of a new species, and described and figured it in a work which he was then publishing on 'The Birds of Europe.' In honour of my having been the first to discover it, he named it after me, *Anthus Seebohmi*. But, alas for the vanity of human wishes! I afterwards discovered that the bird was not new, but had been described some years before from examples obtained on the coast of China. I had subsequently the pleasure of working out its geographical distribution. The honour of having added a new bird to the European list still remains to us, and is one of the discoveries made upon our journey on which we pride ourselves."

Ten days' voyage down the river occupied in this fashion brought the travellers in their boat to Alexievka, the shipping port of the Petchora, where the larch-timber felled on its banks is laden for Cronstadt and other ports. Here their headquarters were fixed until their departure for England on August 1. But the forty days passed here were by no means wasted. The "tundra" on the east bank of the great river, frozen hard and under snow during eight months in the year, becomes in summer a boggy moor covered with carices, mosses, and dwarf shrubs, and varied by abundance of lakes. Untrodden by ordinary man, it was splendid birds'-nesting ground for the ornithologists, who reaped there an abundant harvest. We cannot go separately into the discoveries here made, which are related by Mr. Seebohm in his usual sprightly and energetic style, but they are thus summed up at the conclusion of his volume:—

"Of the half-dozen British birds, the discovery of whose breeding-grounds had baffled the efforts of our ornithologists for so long, we succeeded in bringing home identified eggs of three—the grey plover (Fig. 1), the little stint (Fig. 2), and Bewick's swan. Of the remaining three, two, the sanderling and the knot, were found breeding by Capt. Fielden, in lat. 82°, during the Nares' Arctic expedition, but the breeding-grounds of the curlew sandpiper still remain a mystery. We added several birds to the European list, which had either never been found in Europe before, or only doubtfully so: such as the Siberian chiff-chaff, the Petchora pipit, the Siberian herring-gull, the Arctic forms of the marsh-tit, and the lesser-spotted woodpecker; the yellow-headed wagtail, and the Asiatic stonechat. We brought home careful records of the dates of arrival of the migratory birds which breed in these northern latitudes, besides numerous observations on the habits of little-known birds.

"Our list of skins brought home exceeded 1000, and the eggs were rather more than 600 in number."

The success of the Petchora expedition induced Mr. Seebohm to wish to extend his field of operations into districts yet further east, when it might be expected that some of the few remaining British birds, of which the breeding-haunts were still unknown, would be found nesting. The remotest eastern corner of Europe having been worked out, it was necessary to push on into Asia, and in 1877 an excellent opportunity of doing this presented itself Capt. Wiggins, of Sunderland, one of the pioneers of the recent attempts to reopen sea-communication with Northern Siberia, had succeeded in penetrating some 1200 miles up the Yenesay (Mr. Seebohm's phonetic spelling of Yenisei) in the previous autumn, and having left his vessel there to winter, and returned home overland, was preparing in February of that year to go back to the Yenesay. At a few days' notice Mr. Seebohm undertook to join him in his journey out, wisely thinking that in such an expedition it was as well to have the company of a gentleman who "knew the ropes," although he might have little sympathy with ornithological pursuits.

FIG. 2.—Little Stint's nest, eggs, and young.

Mr. Seebohm and Capt. Wiggins accordingly left London on March 1, and travelled by rail to Nishni Novgorod, a distance of some 2400 miles. Thence was a sledge-journey of about 3200 miles to the winter quarters of the good ship *Thames*, on the Yenesay, or rather a little way up the Koorayika, an affluent of the Yenesay, on its right bank. The crew of the *Thames* who had passed a long and dreary winter, frozen up at this spot, were found on the travellers' arrival to be well and hearty, owing to the judicious precautions that had

FIG. 3.—Driving with the ice on the Koorayika.

been taken by their Captain for the benefit of their health.

On April 23, when the travellers reached the ship, there were no signs of approaching summer on the Yenesay. On the frozen river the snow lay six feet deep, and was little less in the surrounding forests. Mr. Seebohm put on his snow-shoes and had a round with his gun. Birds were more plentiful than could have been expected. A pair of ravens were generally in sight, and flocks of snow-buntings flitted by. Nutcrackers came to the doors of the sailors' room, to pick up the cook's refuse, and Lapp-tits and Pine-grosbeaks were common in the woods. The excursions into the forest were continued every day, and a few additional birds observed, but on May 1 the list of identified species was only twelve in number, and summer seemed nowise nearer. It was not until May 15 that indications of a thaw appeared, and geese were seen travelling north, but the next day was as cold as ever. After that date, however, some slight progress was made: the water in the Koorayika began to rise, and the summer migrants appeared one by one.

The great battle of the Yenesay, as Mr. Seebohm calls the contest between summer and winter, lasted about a fortnight, during which thousands of acres of ice on the river were hurried up and down as the water rose and fell. Sometimes the floes were jammed so tightly together that it looked as though one might cross the river on them, at other times there was open water interspersed only with stray icebergs. At last the final "march-past" of the ice took place; "winter was vanquished for the year," and succeeded in a few days by "the triumphant music of thousands of song-birds, the waving of green boughs, and the illumination of gay flowers of every hue."

It was not until June 26 that the *Thames* was able to steam away down the river. By this date Mr. Seebohm and his collectors had made large collections of birds and eggs, and having exhausted the novelties of the surrounding district, were heartily glad to be off northwards to fresh fields of research. Unfortunately, after about a week's navigation, the *Thames* grounded on a shoal, and, as the water was falling rapidly, could not, in spite of every effort, be got off again. All that could be done was to move what was necessary into the *Ibis*—a small vessel built on the river—and to continue the voyage down the Yenesay, leaving the *Thames* to her fate.

On nearing the embrochure of the Yenesay, on July 12, a gale compelled the *Ibis* to cast anchor, and advantage was taken of the delay to explore the adjacent "tundra"—

FIG. 4.—Summer quarters on the Koorayika.

"a wild-looking country full of lakes, swamps, and rivers, a dead flat in some places, in others undulating, even hilly—brilliant with wild flowers, swarming with mosquitoes, and full of birds." Here one of the great discoveries of the second expedition was made, which is described by the author in his usual lively manner:—

"The gale continued next day with rain, until noon, when I took advantage of our enforced delay, and went on shore for a few hours. A climb of about 100 feet brought me on to the tundra. In some places the cliffs were very steep, and were naked mud or clay. In others the slope was more gradual, and covered with willow and alder bushes. In these trees Thrushes were breeding. I soon found the nest of a Dusky Ouzel, with five nearly fledged young. It was placed as before in the fork of a willow, level with the ground. On the top of the bank I found myself on the real Tundra. Not a trace of a pine tree was visible, and the birch trees rarely exceeded twelve inches in height. There was less grass, more moss and lichen, and the ground was covered with patches of yellow mud or clay, in which were a few small stones, that were apparently too barren for even moss or lichen to grow upon. The Tundra was hilly, with lakes, swamps, and bogs in the wide valleys and plains.

"As soon as I reached the flat bogs I heard the plaintive cry of a Plover, and presently caught sight of two birds. The male was very conspicuous, but all my attempts to follow the female with my glass, in order to trace her to the nest, proved ineffectual, she was too nearly the colour of the ground, and the herbage was too high. Feeling convinced that I was within thirty paces of the nest, I shot the male, and commenced a diligent search. The bird proved to be the Asiatic Golden Plover, with gray axillaries, and I determined to devote at least an hour looking for the nest. By a wonderful piece of good fortune I found it, with four eggs, in less than five minutes. It was merely a hollow in the ground upon a piece of turfy land, overgrown with moss and lichen, and was lined with broken stalks of reindeer moss. The eggs resembled more those of the Golden than those of the Grey Plover, but were smaller than either.

"These are the only authenticated eggs of this species known in collections."

Golcheeka, the port at the mouth of the Yenesay, was reached on July 18. As Mr. Seebohm did not think it prudent to attempt the sea-passage home in the little *Ibis*, and the last steamer of the season up the Yenesay was to leave six days afterwards, little could be done in this locality. But excursions were made over the adjoining tundra, where "birds were abundant." "Golden Plovers, Arctic Terns, Ruffs, Red-necked Phalaropes, Snow-buntings, Lapland Buntings, and Dunlins were continually in sight, and the Asiatic Golden Plover was breeding in numbers, though attempts to watch them on to their nests were made in vain." On July 24 Mr. Seebohm finally turned his face homewards, and reached Yenesaisk on August 14, after twenty-two days on the road, which was considered "a good passage." Thence post-horses, steamers, and railways brought him back to Sheffield on October 15, after a journey of some 15,000 miles.

The ornithological results of the second journey were "on the whole satisfactory." It was a great disappointment not to get to the coast, and still more so to miss the birds of the Kara Sea, and to arrive on the tundra too late for most of the eggs specially sought for. This misfortune was caused by the wreck of the *Thames*. But on the other hand "the delay in the pine-forests produced some very interesting results." Besides the eggs of the Asiatic Golden Plover already spoken of, nests and eggs of three species of Willow-warblers, of the Mountain-Accentor, of the Little Bunting, and of the Red-breasted Goose were obtained. All these were previously unknown to western collectors, and were for the most part never previously obtained. Besides this, a large number of other rare birds were found nesting, their eggs and young plumages obtained, and their habits and manners studied and recorded. Concerning particulars of their discoveries, and for much information on the native tribes of Northern Siberia (a subject to which our author appears to have devoted great attention), as likewise for observations on every other incident coming before the eyes of an intelligent traveller during a journey of 15,000 miles, we must refer our readers to Mr. Seebohm's volumes, which are full of interest not only to ornithologists, but to those who take pleasure in natural history in its widest extent. They may be placed on our shelves next to Bates's "Amazons" and Wallace's "Eastern Archipelago," and form no unworthy companions to the works of those great naturalists.

THE BACILLUS OF TUBERCLE

MR. WATSON CHEYNE'S Report on the Relation of Micro-organisms to Tuberculosis, published in the *Practitioner* for the present month, is one of the fruits of the Association for the Advancement of Medicine by Research, recently constituted for the protection of working physiologists and pathologists. On commission from the Association, Mr. Cheyne visited two of the chief workers on this subject, Toussaint and Koch. He was thus able to see their methods and obtained materials from them with which he has experimented on his return to England.

After some remarks on the method of staining the tubercle bacillus, Mr. Cheyne describes some experiments made with the view of testing the theory that tuberculosis in rodents can be induced by almost any irritant. The result of these experiments, made on a considerable number of animals, was to disprove this theory and to lead to the conclusion that in the former experiments, made before our present knowledge as to the precautions necessary for disinfection of instruments, &c., was gained, the channels for the introduction of specific micro-organisms had been left unguarded.

Experiments were next made to test Toussaint's statement that micrococci can be cultivated from the blood of tuberculous animals, and that the injection of these micrococci into other animals is often followed by tuberculosis. Mr. Cheyne failed to cultivate micrococci from the blood of tuberculous animals; he injected micrococci which M. Toussaint had liberally placed at his disposal, into a considerable number of animals without result, and he found tubercle-bacilli but no micrococci in the organs of several animals which had been injected by Toussaint himself with micrococcal fluid, and had become tuberculous. He therefore concludes that Toussaint's micrococci do not cause tuberculosis, and that an error has crept into his experiments probably because the means used to disinfect his syringes, although amply sufficient to destroy some other kinds of bacilli, did not destroy the tubercle-bacilli.

Cultivations of bacilli were also obtained from Dr. Koch, and the results of their inoculation was in all cases rapid development of tuberculosis. The examination of a large quantity of tuberculous material showed the constant presence of tubercle-bacilli, but of no other micro-organisms. The rapidity and certainty of action of tuberculous material when inoculated into animals was in direct ratio to the number of bacilli introduced, and the most certain and rapid means of inducing tuberculosis in animals is the inoculation of the tubercle-bacillus cultivated on solidified blood-serum. These facts lead Mr. Cheyne to the conclusion that we have before us in these bacilli the virus of the acute tuberculosis caused in animals by the inoculation of tuberculous material.

Pursuing the inquiry from this point, to which it had been brought by the researches of Koch, Mr. Cheyne proceeds to discuss the relation of these bacilli to tuberculous processes in man and to tubercle generally. In all tubercles there are present epithelioid cells, to which, however, only a few authors have attached any importance. On investigation Mr. Cheyne found that the tubercle-bacilli were, unless when present in large numbers, only found in or among these epithelioid cells, and that the tuberculous nodules first begin by the entrance of bacilli into these cells and the subsequent development of the epithelioid elements. Surrounding these epithelioid cells a slight amount of inflammation occurs, giving rise to the small-celled growth around the tubercle, which is generally regarded as the growing part of the tubercle. This Mr. Cheyne denies, asserting that it is merely inflammatory tissue, and that the essential elements of the tubercle are the epithelioid elements in its centre. In the lungs these cells seem to be derived from the alveolar epithelium, in the liver often apparently from the liver cells, but in other organs and also sometimes in these from the endothelium of the lymphatics and blood-vessels.

In phthisis the bacilli were found at the margin of cavities and in the epithelioid cells surrounding the cheesy matter. Mr. Cheyne concludes that in phthisis the bacilli, inhaled into the alveoli, develop in the alveolar epithelium, cause accumulation of epithelial cells in the alveolus, and inflammatory hypertrophy of its walls. Thus the bacilli are practically shut off from the circulation and acute general tuberculosis cannot occur. The two extremes of phthisis are considered—the very rapid form or caseous pneumonia, and the slow form or fibroid phthisis. In the former the bacilli grow rapidly, are fairly numerous, and the lung rapidly breaks down; in the latter the bacilli grow slowly and with difficulty, and hence extensive fibrous formation occurs.

There are many other points of interest in this research to which we cannot allude, but which will be found at length in the Report. The Association is to be congratulated on having chosen such a fertile subject for their first report, and we hope that they will continue to encourage similar work.

PROFESSOR H. J. S. SMITH AND THE REPRESENTATION OF A NUMBER AS A SUM OF SQUARES

THE award of the great Mathematical Prize of the French Academy to the late Prof. H. J. S. Smith may have the effect of drawing the attention of mathematicians to the wonderful extent and value of his researches on the Theory of Numbers. Probably no more important or remarkable mathematical investigations have ever appeared in this country than his memoirs on systems of linear indeterminate equations and congruences and on the orders and genera of ternary quadratic forms and of quadratic forms containing more than three indeterminates, which were published in the *Philosophical Transactions* for 1861 and 1867 and the *Proceedings of the Royal Society* for 1864 and 1867. The results contained in these papers are by far the greatest additions that have been made to the Theory of Numbers since it was placed on its present foundation by Gauss in the "Disquisitiones Arithmeticæ." The subject for which the prize was awarded to Prof. Smith was that of the theory of the representation of a number as a sum of five squares, and of this question as well as that of the corresponding one for seven squares he had given the complete solution in the *Proceedings of the Royal Society* for 1867 (vol. xvi. p. 207). The words with which Prof. Smith introduced his statement of the solution of these important questions are as follows:—

"The theorems which have been given by Jacobi, Eisenstein, and recently in great profusion by M. Liouville, relating to the representation of numbers by four squares and other simple quadratic forms, appear to be deducible by a uniform method from the principles indicated in this paper. So also are the theorems relating to the representation of numbers by six and eight squares, which are implicitly contained in the developments given by Jacobi in the 'Fundamenta Nova.' As the series of theorems relating to the representation of numbers by sums of squares ceases, for the reason assigned by Eisenstein, when the number of squares surpasses eight, it is of some importance to complete it. The only cases which have not been fully considered are those of five and seven squares. The principal theorems relating to the case of five squares have indeed been given by Eisenstein (*Crelle's Journal*, vol. xxxv. p. 368); but he has considered only those numbers which are not divisible by any square. We shall here complete his enunciation of those theorems, and shall add the corresponding theorems for the case of seven squares."

In the announcement of the subject for the prize in the *Comptes Rendus* in February of last year, reference was made to the work of Eisenstein, but the fact that his solution had fifteen years before been completed by Prof. Smith—who had also solved the problem in the case of seven squares, the whole being only a corollary from the general principles contained in his memoirs—seems to have escaped the attention of the propcsers of the subject. In the paper in the *Proceedings of the Royal Society* the results only for the case of five squares and seven squares are given, the demonstrations being omitted; and accordingly, when the subject for the prize was announced, Prof. Smith followed the only course open to him, and communicated to the Academy his demonstrations for the case of five squares.

All who knew Prof. Smith will understand how uncongenial to him was the idea of becoming a competitor for the prize, but under the circumstances he had no choice. It is a singular tribute to Prof. Smith's mathematical powers, as well as a curious episode in the history of mathematics, that the French Academy should have chosen as the subject of the "Grand Prix"—thereby indicating their opinion of its importance in the advance of the science[1]—a question that had been solved already fifteen years before as a corollary from more general principles.

The state of the question of the number of ways in which a number can be expressed as a sum of squares therefore stands as follows:—For two squares the solution was given by Gauss in the "Disquisitiones"; the cases of four, six, and eight squares are due to Jacobi, Eisenstein, and Prof. Smith (see *Report of the British Association for* 1865, p. 366). In these cases in which the number of squares is even, the problem can be solved by means of elliptic functions, and it is not necessary to have recourse to the special methods of the Theory of Numbers; but it is not so in the case when the number of squares is uneven, and the question is then essentially "arithmetical" as regards its method of treatment and expression. The case of three squares was given by Lejeune-Dirichlet, and is included in Prof. Smith's general treatment of ternary quadratic forms in the *Philosophical Transactions* for 1867: the enunciations for the cases of five squares and seven squares were given, as has been stated, in the *Proceedings of the Royal Society for* 1867. The demonstrations for the case of five squares have been communicated to the French Academy, but those for seven squares still remain unpublished in Prof. Smith's note-book. This class of questions ceases to admit of the same kind of solution when the number of squares exceeds eight, so that with the publication of the demonstrations for seven squares the solution of the whole problem will be complete. It will be seen that Prof. Smith has had a large share in this great mathematical victory.

[1] "L'Académie était donc fondée à espérer que ce voyage de découvertes imposé aux concurrents à travers une des régions les plus intéressantes et les moins explorées de l'arithmétique produirait des résultats féconds pour la science. Cette attente n'a pas été trompée." Report on the award of the prize, *Comptes Rendus*, April 2, 1883. In this report however no mention is made of the fact that these "résultats féconds" had been published in 1867.

NOTES

The Queen has signified her intention of conferring the honour of Knighthood upon Prof. Frederick Augustus Abel, C.B., F.R.S., in recognition of the valuable services rendered by him to the War Department and to other departments of the Government in his capacity of War Department Chemist.

Her Majesty has also been pleased to confer the honour of Knight Commandership of the Bath on the Right Hon. Lyon Playfair, C.B., M.P., F.R.S.

We are glad to learn that the Hong Kong Observatory scheme, to which we have frequently adverted, has at last become so far a *fait accompli* that Dr. Doberck of the Dunsink Observatory has been appointed astronomer to the new institution by the Secretary for the Colonies. The opportunities afforded for independent and original work in Hong Kong are very great, and we are sure the head of the new Observatory will make the most of them. Dr. Doberck is at present attached to the Kew Observatory, and expects to leave England with his first assistant early in June. Lord Derby is taking a marked interest in the new Observatory, and we are glad to learn is making Dr. Doberck a very liberal allowance for the purchase of instruments.

The Davis Lectures for 1883 will be given in the lecture room in the Zoological Society's Gardens, in the Regent's Park, on Thursdays, at 5 p.m., commencing June 7, as follows:—June 7, Ungulate Mammals, by Prof. Flower, LL.D., F.R.S.; June 14, Our Snakes and Lizards, by Prof. Mivart, F.R.S.; June 21, The Lamprey and its Kindred, by Prof. Parker, F.R.S.; June 28, Birds and Lighthouses, by J. E. Harting; July 5, The Niger and its Animals, by W. A. Forbes; July 12, South American Birds, by P. L. Sclater, F.R.S.; July 19, The Siberian Tundra, by Henry Seebohm. These lectures will be free to Fellows of the Society and their friends, and to other visitors to the Gardens.

Our readers will doubtless be surprised to learn that the masterly address on Darwin and Copernicus, of which we publish a translation in another column, has called forth much hostile criticism in Germany. It was read before the members of the Berlin Academy of Sciences, of which Prof. Du Bois Reymond is Secretary, at their last annual meeting. Shortly afterwards one of the Clerico-Conservative newspapers of the German capital called attention to what it was pleased to call the public laudation of one of the worst and most dangerous atheists by a member of a public body supported by the State. Many other papers of the same views immediately followed suit; while the notorious Court Chaplain, Stöcker, whose exploits as a Jew-baiter furnished the Berlin correspondents of the daily papers with a good deal of matter about twelve months ago, preached a long sermon against Prof. Du Bois Reymond and his views. His example was followed by other members of the so-called "Orthodox" clergy in Berlin and the provinces. But the Court Chaplain is also a member of the Prussian Parliament; so not content with crushing "atheism" from the pulpit, he put a question in the House on the subject, supported by Herr Windthorst, one of the leaders of the Ultramontane party. They were answered by Prof. Virchow and the Prussian Minister of Public Instruction, thus causing a whole sitting of the Prussian Landtag to be taken up by a debate on the graceful tribute to the memory of Darwin. That such things should take place in Germany, which has always been considered the home of philosophic freedom, really seems to justify the remark of the author of "Darwin and Copernicus," that freedom of thought, which, after taking its rise in England in the middle of the eighteenth century, passed through France to Germany, where it attained a fuller and more systematic development, seems now to be passing away from the latter country again! Let us hope that it is coming to our shores once more, as the Professor says it is.

The Swedish subscription to the Darwin Memorial is now closed. The number of subscribers is 2294, and the amount subscribed 400*l*.

The *Times* Paris correspondent telegraphs as follows under date April 10:—A shameful trick has been played on the Academy of Sciences. The Königsberg student, Hermann Minkowsky, who with the late Prof. Henry J. S. Smith was declared to have gained the great mathematical prize of 3000 francs, had simply pirated Prof. Smith's communication to the Royal Society in 1868, on the representation of a number as the sum of five squares. He had even copied a slight error in it. The Academy, therefore, at a secret session yesterday annulled its original decision and declared that the whole prize had been gained by the distinguished English professor, who unfortunately has not lived long enough to expose the hoax.

We would again draw the attention of local scientific societies to the circular which has been issued by the Committee of the British Association appointed to consider certain matters in connection with such societies. These societies will be doing themselves as well as the Committee service by forwarding the information desired without further delay.

The Scotch Universities Bill, which has been introduced by the Lord Advocate, establishes an Executive Commission, and gives them extensive powers for reorganising the Universities, including the power of revising existing foundations and endowments, and of founding new Professorships. They will also have authority to affiliate Colleges in other parts of the country with the University of St. Andrews; and, if satisfied that that University is no longer able to perform its functions, to dissolve it, and create a new Corporation. The Bill also proposes that a grant of forty thousand pounds a year shall be given to the Scotch Universities from the Consolidated Fund.

The committee for the organisation of the Congress of Orientalists in Holland has issued a circular letter explaining the reasons for the alteration of the time of meeting of the Congress at Leyden from 1884 to the present year. The last congress, which met at Berlin in 1881, decided that the next should take place at Leyden in 1884; but, the committee say, since then, as it has been arranged that an international colonial exhibition was to be held in Amsterdam this year, it was thought better, after consultation with the previous committee, and after having obtained the sanction of the Netherlands Government, to hold the Oriental Congress at the same time. It is accordingly notified that the Congress will assemble at Leyden from September 10 to 15 of the present year. A small exhibition of literary curiosities, manuscripts, rare books, &c., will be held at the same time. Oriental scholars desirous of being present, or of reading papers, are invited to communicate with Mr. W. Pleyte of Leyden before the end of July, in order that the necessary accommodation may be prepared.

The *Japan Mail* in announcing recently the death of a student of the Imperial College of Engineering, Mr. Yamada, from over-study, refers to his docility, untiring assiduity, and very remarkable ability. The writer, who appears to possess intimate knowledge of the subject, speaks thus of Japanese students in general:—"It is hard for those to think ill of Japan who have watched these gentle, earnest-hearted lads, set themselves, almost before they have ceased to be children, with unflagging resolution to accomplish the task their fathers bequeathed to them unattempted, the task of winning for their country the place they hope to see her one day occupy. 'Very fine, forsooth!' we can hear your professional maligner exclaim, 'but after all what have they done?' Ay, indeed, what have they done! Doubtless they never ask themselves that question. Doubtless they never have to struggle against the paralysing consciousness that the most they can hope to do is to lay a foundation for others to build on, to play the brave part of those silent workers who sow that their successors may reap. That is not much, to be sure, so far at least as visible results are concerned, but it is a work incomparably higher than anything within reach of those cowardly cynics who toil for nothing but to make the world forget that the noblest of English attributes is generosity."

DR. G. W. LEITNER, the explorer and orientalist, is now on his way to England.

A COMPANY has been formed for the construction and working of an electric railway from Charing Cross to Waterloo, a Bill for which was recently obtained. The line will pass under the Thames through iron caissons. The work of construction will commence near the northern end of Northumberland Avenue, opposite the Grand Hotel, and be continued through an arch under that avenue and the Victoria Embankment. Of that arch sixty feet under the Embankment have already been constructed. The railway will pass under the Thames, and again through an arch under College Street and Vine Street, and terminate at Waterloo Station, where it will be directly connected with the platforms of the London and South-Western Railway, with a separate approach from the York Road. The line will be double, and worked by means of a stationary engine at Waterloo, transmitting the power to the carriages, which will run separately, start as filled, and occupy about three and a half minutes in the journey. A tender has been accepted for the construction of the railway, to be ready for opening within eighteen months from the commencement of the work. A contract has also been made with Messrs. Siemens Bros. and Company to provide and erect all requisite electrical machinery, rolling stock, and apparatus not included in the before-mentioned tender.

IN connection with the meeting of the Civil Engineers on Saturday the *Times* makes some very definite statements on the position and function of science in our time, which are worth placing on record as the deliberate opinion of a leading organ of public opinion:—"Meetings such as that of Saturday evening remind us not merely of the services of a particular branch of science to mankind, but of the remarkable determination of human activity to scientific pursuits which is characteristic of the present age. Literature no longer holds the place it once did in the minds of men; nor does it command, as it once did, the services of the most powerful intelligences. The protest against an education wholly or chiefly consisting of the study of the classics is the result of a profound change in the conditions of life. Men have not deliberately and as a result of abstract reasoning discarded one set of studies in favour of another. On the contrary they have discovered, often to their great chagrin, that a complete intellectual displacement has taken place. That which was taken up under protest as a thing too closely connected with utilitarian pursuits to be quite worthy of a man of intellect has now pressed into its service the chief intellectual power of the country. The tide of intellectual effort sets strongly in the direction of science, just as at an earlier period it set in the direction of letters. The teachers and leaders of the day, the real dominant forces of the age, are the men of science, the investigators of natural phenomena, not the thinkers, philosophers, or metaphysicians who formerly gave their names to sects, and made all the world their partisans. Nothing is more remarkable than the profound respect of the scientific conception associated with the name of Darwin, not on science only, but on literature, art, morals, and, in short, upon life. Some will tell us that all this is a lamentable result of the materialism of the age, but we naturally ask how it happens that some centuries of a non-scientific or literary culture left us a prey to the materialism it is supposed to antidote? It is untrue, moreover, that material interest has been the great impelling force. The great discoveries of science have usually been made by men seeking no material reward, and, as a matter of fact, receiving very little. Science pursues her own way for the most part, and her discoveries are afterwards utilised by men eagerly seeking for the means of material enrichment. Even when it is a question of so practical a thing as a new dye, it will be found that the chemist searching into the properties and combinations of matter, comes upon the secret unawares, while the manufacturer and the dyer reap the profits. It is indeed, only upon these terms that nature yields up her secrets."

THE death is announced at Basle of Dr. Ziegler, who has been long and honourably known for his numerous and remarkable works in cartography. Born at Winterthur in 1801, he began his studies under the direction of Carl Ritter, the creator of modern geography. At a later period of his life he established in his native town the cartographic establishment which is now conducted by Messrs. Wurster and Randegger. From Winterthur he proceeded to Basle, and a few years ago, in testimony of his gratitude for the kindness with which he was received there, he presented to the city of his adoption his magnificent collection of ancient and modern maps. For the conservation and augmentation of this collection a special society has been formed. Dr. Ziegler's most important works are his great map of Switzerland, maps of Glarus, of St. Gall, and of the Engadine, and a hypsometric map of the world. His last work, completed shortly before his death, and now in the press, was a geological atlas and an explanatory description of the geological map of Switzerland.

UNDER the title of "Cacao: How to Grow and how to Cure it," Mr. D. Morris, the Director of the Public Gardens and Plantations in Jamaica, has issued a pamphlet of some 45 pages. It is divided into chapters, the first of which is of an introductory character, and treats of the character of climate and soil of Jamaica, the abolition of slavery and its consequent effects upon the cultivation of the sugar-cane, and the necessity at the present time to plant new economic plants, and a consideration of the prospects of cocoa planting. On this point Mr. Morris says: "I am glad to say that the largest number of the best Trinidad varieties distributed from the Public Gardens during the last five or six years have been intelligently and carefully cultivated on portions of sugar estates which, although unsuitable for canes, are admirably adapted for cacao." Mr. Morris's remaining chapters are devoted to the following considerations: Historica description; cultivation of cocoa; how to start a cacao plantation; planting, pruning, gathering, sweating, curing; yield of cocoa-trees; cost of establishing estates, &c. Under these several heads much interesting and useful information is given, as, for instance, on the original home of the cacao plant, the introduction of cacao or chocolate into England, its consumption in Europe and Great Britain. As a guide to planters or those intending to introduce cacao as a crop, the succeeding chapters will be of much value. The little book is both readable and useful, and can be obtained in this country of Messrs. S. W. Silver and Co.

ALTHOUGH the Chinese Educational Mission has been recalled from the United States before its work was done, through some fancy, we believe, that the young men composing it were becoming too republican in their ideas, yet the results have been in many respects gratifying to those who desire to see Western knowledge spread in China. The youths have been drafted to telegraph stations, arsenals, and elsewhere, and we observe that the secretary and interpreter, Mr. Kwong ki Chin, who recently published a bulky volume of English phrases, is now preparing a series of schoolbooks for use in Chinese government schools. An English reading-book for beginners, an elementary geography, a series of conversation books, and a manual of English correspondence have either been already published, or will shortly appear. Among many other indications of the steady, though slow, advance of the Chinese in this direction, the Peking correspondent of the *North China Herald* refers with regret to the retirement from business of Mr. Yang, a well-known pawnbroker of the metropolis. In addition to the ordinary duties of his calling this individual appears to have studied chemistry, mechanical science, French, mineralogy, medicine, and other subjects of a similar kind. He owned gasworks, steam-engines, a complete pharmacopeia of drugs, photographic apparatus, and a geological cabinet. It is to be hoped that Mr. Yang has prospered in his business, because he has retired to his native province, Shansi, where he intends prosecuting enterprises for coal and iron mining, and other appliances of foreign machinery. When tastes of this kind extend to the shrewd and enterprising Chinese traders, we need not despair of the outlook for science in China.

SOME time since we alluded to the work done in China by an American female physician, Miss Dr. Howard. She has attended the mother of Li Hung Chang, the great Viceroy, and now we read she is treating the wife of the same high official. The fame of the lady doctor appears to have spread far and wide over North China, and she is now flooded with applications for assistance and advice from the women of wealthy families, who would die rather than be treated by a foreign male physician. It looks as if the various countries of the East offered an almost inexhaustible field for women possessing medical knowledge and skill.

THE Annual Report of the Glasgow Museum is as favourable as can be expected, considering the totally inadequate space allotted for the purpose in one of the wealthiest cities of the world.

PROF. H. CARRINGTON BOLTON has issued in a separate form his address on Chemical Literature, delivered before the American Association at Montreal last year.

FOR Baron Nordenskjöld's coming expedition to Greenland a flying-machine is now being constructed in Gothenburg. The apparatus, a kind of flying or air-sailing machine, is the invention of a Swedish engineer, Herr A. Montén, who is now constructing the same at the expense of Dr. Oscar Dickson.

ON the night of April 3, frequent and violent shocks of earthquake were felt at Pedara in Sicily.

THE additions to the Zoological Society's Gardens during the past week include a Leonine Monkey (*Macacus leoninus* ♂) from Arracan, presented by Mr. A. G. Henry; a Mule Deer (*Cervus macrotis* ♀) from North America, presented by Judge Caton, C.M.Z.S.; a Common Squirrel (*Sciurus vulgaris* ♀), British, presented by Miss A. M. Frost; a Common Pintail (*Dafila acuta* ♂), British, presented by Mr. Frank Seago; a Grey-lag Goose (*Anser ferus*), British, presented by Mr. Vincent W. Corbett; four Palmated Newts (*Triton palmipes*), British, presented by Mr. J. E. Kelsall; a Radiated Tortoise (*Testudo radiata*) from Madagascar, deposited; a Black Saki (*Pithecia satanas* ♀), a White-bellied Parrot (*Caica leucogastra*) from the Amazons, a Talapoin Monkey (*Cercopithecus talapoin* ♂), four Harlequin Quails (*Coturnix histrionica* ♂ ♂ ♀ ♀) from West Africa, a Brazilian Blue Grosbeak (*Guiraca cærulea*), four Saffron Finches (*Sycalis flaveola* ♂ ♂ ♂ ♀) from Brazil, purchased.

OUR ASTRONOMICAL COLUMN

D'ARREST'S COMET.—On April 4 a.m. this comet was re-observed by Dr. Hartwig with the 20-inch refractor of the Observatory of Strasburg, near the position indicated by the elements of M. Leveau of Paris. The observation is a notable one, having been made at the great interval of 285 days from the date of perihelion passage; no other comet of short period has been hitherto observed under such circumstances, indeed there is only one instance upon record where a comet has been observed further from perihelion passage, and this was in the case of the celebrated comet of 1811, which was in perihelion on Sept. 12 in that year, and was followed by Wisniewsky till Aug. 17, 1812, or 309 days after its nearest approach to the sun. The great comet of 1861 was observed at Pulkowa 284 days after perihelion.

The comet in question was discovered by the late Prof. D'Arrest at Leipsic on June 27, 1851, and was observed at Berlin till October 6; its periodicity was pointed out by the same astronomer in the first week in August. MM. Oudemanns and Schulze specially occupied themselves with the investigation of its orbit in this year. At the next return in 1857 its position did not allow of observations in this hemisphere, but it was observed at the Royal Observatory, Cape of Good Hope, on December 5, and followed until January 18, 1858. The ensuing perihelion passage took place at the end of February, 1864, but from the unfavourable track of the comet in the heavens no observations were procured. During this revolution the comet had approached the planet Jupiter within about 0·36 of the earth's mean distance from the sun, and large perturbations of the elements were thereby produced; the nearest approach occurred in April, 1861. At the returns in 1870 and 1877 observations sufficient for the correction of the elements were obtained; the later investigation of the comet's motion has been ably conducted by M. Leveau.

In 1851 at perihelion the comet was distant from the earth's orbit only 0·162; at the present time this distance has been increased by perturbation to 0·316. There is a very close approach to the orbit of Jupiter, in heliocentric longitude 154°, or at an angular distance of about 165° before perihelion. In the orbit of 1870 the distance was 0·0845, in that of 1884 it is 0·1232; the presumption will therefore be that the attraction of this planet has fixed the comet in the system.

The following positions are calculated from M. Leveau's predicted elements; the perihelion passage occurs 1884, January 13 5765 G.M.T.:—

At Greenwich Midnight

	R.A. h. m. s.	Decl. ° ′	Log. distance from Earth.	Sun.
April 23,	13 38 14 ...	+11 13·7 ...	0·2951 ...	0·4649
25,	,, 36 25 ...	11 27·6		
27,	,, 34 37 ...	11 40·8 ...	0·2927 ...	0·4609
29,	,, 32 50 ...	11 53·2		
May 1,	,, 31 3 ...	12 4·7 ...	0·2912 . .	0·4569
3,	,, 29 18 ...	12 15·3		
5,	,, 27 35 ...	12 25·1 ...	0·2906 ...	0·4528
7,	,, 25 55 ...	12 33·9		
9,	,, 24 18 ...	+12 41·7 ...	0·2908 ...	0·4486

THE SOLAR ECLIPSE IN MAY.—On May 7, on the eastern coast of Australia, the sun will rise in a sea-horizon about the time of greatest eclipse. With favourable weather the observation will be a very interesting and unusual one, more particularly about Sydney, where the magnitude of the eclipse is greatest. It will be seen from the maps in our ephemerides that totality does not reach Australia, but at Sydney the sun will rise at 6h. 38m., within a quarter of an hour after the middle of the phenomenon, when the magnitude will be 0·95. In Queensland the magnitude diminishes to 0·75, and the sun will be in the horizon at greatest phase. At the former place, therefore, a narrow crescent emerging from the sea-horizon will constitute apparent sunrise.

PHYSICS IN RUSSIA DURING THE LAST TEN YEARS[1]

THE Russian Physical Society was founded only ten years ago, and since its foundation it has become the centre of all researches in physics carried on in Russia, which were limited before to a few dissertations written by Russian Professors of Physics in German Universities, and to a few memoirs communicated to the Academy of Sciences. At present the

[1] Historical sketch of the work done by the Physical Society at the University of St. Petersburg during the last ten years by N. Hesehus in the *Journal of the Russian Chemical and Physical Society*, vol. xiv. fasc. ix.

Society has 120 members, a capital of 1638*l.*, a library, and a physical laboratory, mostly of instruments presented by M. Bazilevsky. As to the scientific communications made to the Society, they are of great value, as will be seen from the following brief summary.

The first rank among them belongs to the researches of Prof. Mendeléeff, which are nearly all connected with his extensive work on the elasticity of gases, these last leading him to a great number of collateral researches, and to the invention of new methods and instruments. Such are, for instance, his communications:—1. On a differential naphtha-barometer intended to show small changes of pressure. 2. On a levelling instrument, being a modification of the former, and easily showing changes of level of one metre; it might be applied also to the measurement of the changes of density of air; an entire memoir was written by M. Mendeléeff to describe this apparatus, which is susceptible of so many applications. 3. On a means of boiling mercury in barometers. 4. On a new siphon-barometer, which is, so to say, a combination of two siphon barometers connected together in their upper parts, one of the two tubes being capillary, and serving to exhaust the air which may penetrate Torricelli's vacuum, and for filling the instrument with mercury. 5. On a mercury pump which eliminates the disadvantages of friction. 6. On a very sensitive differential thermometer. 7. On a formula of expansion of mercury from temperature: the volume at a temperature t being $= 100,000 + 17{\cdot}99\ t + 0{\cdot}002112\ t^2$, where 100,000 represents the volume at zero. 8. On the coefficient of expansion of air; the experiments were made with great accuracy, and the volumes measured by the weight of mercury; the coefficient was found to be $\alpha = 0{\cdot}0036843$. 9. On the temperature of the upper strata of the atmosphere; according to the measurements of Mr. Glaisher, Prof. Mendeléeff found that the increase of temperature (t) is equal to the increase of pressure (H); that is, $\frac{dt}{dH} =$ *Const.*, or $t = C + H\frac{t_0 - C}{H_0}$. Taking, then, into account the influence of moisture, Prof. Mendeléeff deduced, from the laws of the mechanical theory of heat, a formula which better agrees with observations than the formula of Poisson, deduced for dry air. An accurate knowledge of the law of changes of temperature in the upper parts of the atmosphere having an immense importance for meteorology, astronomy, and cosmography, Prof. Mendeléeff elaborated a thorough scheme of aërostatic observations in Russia. 10. On a general formula for gases; instead of the well-known formulæ of Clapeyron, he proposes the following, which embodies the laws of Marriott, Gay-Lussac, and Avogadro:—$A\ P\ V = K M\ (C + T)$, where M is the weight of the gas in kilogrammes, and A – its molecular weight, the atomic weight of hydrogen being taken as unity; K is a constant for all gases, whilst the R of Clapeyron varies with the nature and mass of the gas. 11. On the compressibility of air under pressures less than that of the atmosphere; the chief results for pressures from 650 millimetres to 0·5 millimetre are: the law of Marriott not only is not true for low pressures, but the disagreement increases as the pressure decreases; the produce $P\ V$ (pressure multiplied by the volume), at pressures from 0·5 to 650 millimetres, *increases* for the air approximately from 100 to 150, instead of decreasing, as resulted from Regnault's measurements under higher pressures. This result was so unexpected and so contrary to current opinion that the measurements were repeated many times and by different methods, but the result was always the same. So it must be inferred (to use Prof. Mendeléeff's own words) "that as the rarefaction of gases goes on, a maximum volume, or limit volume, is reached, like the minimum or limit volume reached at compression; therefore it cannot be said that a gas, when rarefied, merges into luminous ether, and that the atmosphere of the earth has no limits." The rarefied gas becomes, so to speak, like a solid body. If the pressure on a solid is diminished its volume increases, but at a pressure equal to zero it still attains a limit volume. There are many other communications of less importance which were made also by Prof. Mendeléeff.

Some communications by M. Kraevich were also connected with the same subject. He made investigations into the degree of rarefaction reached in mercury-pumps; into the luminous phenomena in Geissler tubes; into the dissociation of sulphuric acid and glycerine in vacuum, and so on. A special interest is attached to his preliminary experiments on rarefied air by a new method, which experiments lead to the conclusion that "after a certain limit of rarefaction the elasticity decreases much more rapidly than the density, and at a very great degree of rarefaction the air loses its elasticity." These experiments would thus confirm the researches of Prof. Mendeléeff.—M. Kraevich has described an improved barometrograph, a portable barometer, and a mercury-pump of his own invention.

Several improvements of the barometer were proposed, too, by MM. Shpakovsky, Gutkovsky, Reinbot, and others. M. Lachinoff has proposed a mercury-pump without cocks. To the same department belong also the researches by M. Rykacheff into the resistance of the air; by M. Eleneff, on the coefficients of compressibility of several hydrocarbons; by M. Sreznevsky, on the evaporation of water-solutions of the chlorate of zinc; and by M. Schiff, on the compression of indiarubber cylinders.

In mechanics and mechanical physics M. Hesehus notices the works, by M. Bobyleff, on the weighing methods of Borda and Gauss; on the length of the seconds-pendulum at Kharkoff, by M. Osiroff, and several other communications by MM. Bobyleff, Schiller, Lapunoff, and Gagarin.

Calorific phenomena were the subject of many communications, we notice these: On the calibration of thermometers, by MM. Mendeléeff and Lermontoff; on the expansion of mercury and gases, by M. Mendeléeff; a formula of expansion of mercury and water, by M. Rosenberg; on the expansion of indiarubber, by M. Lebedeff; on a new method of determining the caloric conductibility of bodies by heating them at one end, by Prof. Petrushevsky; and several communications on the critical temperature, by MM. Avenarius, Jouk, and Strauss.

The communications on optics were numerous, and we notice among them the descriptions of an optical micrometer based on Newton's rings; and of a spectrophotometer, by Prof. Petrushevsky; the very interesting researches of M. Ewald on the phenomena of vision; the researches into the chemical action of light, by M. Lermontoff, who has tried to prove that light produces a dissociation of molecules and a new distribution of atoms whose return to their former distribution produces the phenomena of phosphorescence; several communications dealing with reflexion in mirrors; several papers on spectrum analysis; and researches dealing with photography.

The communications on electricity were as numerous as all the others taken together, the chief of them being: On the distribution of electricity on spheres under different conditions, and two other papers on electrostatics, of less importance, by M. Bobyleff; on the magnetisation of fine steel cylinders, by M. Khivolson, who has proposed a theory of residual magnetism, explaining these phenomena by the influence of molecules of carbon, which prevent to some extent the rotation of the molecules of iron; researches by M. Van der Flith on the mechanism of the interior and exterior phenomena of the current, which are explained by the molecular rotation in the circuit and by the breaking of equilibrium in the surrounding ether; the papers on thermoelectricity by Prof. Petrushevsky and M. Borgman, and several other papers by M. Borgman, Prof. Lenz, and Prof. Umoff; the microscopical researches into the crystallisation of the metal of electrodes, by M. Shidlovsky; and many others which it would be impossible to enumerate in this note. It will be sufficient to mention that the number of proposed electrical apparatus, as well as of papers on electro-technics, was very great, and some of them were of great value.

Cosmical physics was represented by most valuable papers on the resisting medium in space, by M. Asten; on the transits of Venus and Mercury, on variable and double stars, and on the parallax of refraction, by M. Glasenap; on the tails of the comets *b* and *c*, 1881, by Prof. Bredikhin; and by several interesting communications of MM. Woeikoff, Mendeléeff, Rykacheff, Schwedoff, and many others.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 1.—"Contributions to the Chemistry of Storage Batteries," by E. Frankland, D.C.L., F.R.S.

1. *Chemical Reactions.*—The chemical changes occurring during the charging and discharging of storage batteries have been the subject of considerable difference of opinion amongst chemists and physicists. Some writers believe that much of the storage effect depends upon the occlusion of oxygen and hydrogen gases by the positive and negative plates or by the active material thereon; some contend that lead sulphate plays an important

part; whilst others assert that no chemical change of this sulphate occurs either in the charging or discharging of the plates.

To test the first of these opinions, I made two plates of strips of thin lead twisted into corkscrew form, and after filling the gutter of the screw with minium, so as to form a cylinder that could be afterwards introduced into a piece of combustion tubing, these plates were immersed in dilute sulphuric acid and charged by the dynamo-current in the usual manner. The charging was continued until the whole of the minium on the + and − plates respectively was converted into lead peroxide and spongy lead, and until gas bubbles streamed from the pores of the two cylinders.

After removal from the acid the plates were superficially dried by filter-paper, and immediately introduced into separate pieces of combustion tubing previously drawn out at one end, so as to form gas delivery tubes. The wide ends of these tubes were then sealed before the blowpipe, care being taken not to allow the heat to reach the inclosed cylinders. The tube containing the cylinder of reduced lead was now gradually heated until the lead melted, the drawn-out end of the tube meanwhile dipping into a pneumatic trough. The gas expelled from the tube consisted almost exclusively of the expanded air of the tube and contained mere traces of hydrogen.

The tube containing the cylinder of lead peroxide was similarly treated, except that the heat was not carried high enough to decompose the peroxide. Mere traces, if any, of occluded oxygen were evolved.

These results justify the conclusion that occluded gases play practically no part in the phenomena of the storage cell.

With regard to the function of lead sulphate in storage batteries, I have observed that during the so-called "formation" of a storage cell a very large amount of sulphuric acid disappears from the liquid contents of the cell: indeed, sometimes the whole of it is withdrawn. The acid so removed must be employed in the formation of insoluble lead sulphate upon the plates which, in fact, soon become coated with a white deposit of the salt, formed equally upon both positive and negative surfaces. This visible deposit is, however, very superficial, and does not account for more than a very small fraction of the acid which actually disappears from solution. The great bulk of the lead sulphate cannot be discovered by the eye, owing to its admixture with chocolate-coloured lead peroxide.

Unless the coated plates have been previously immersed for several days in dilute sulphuric acid, this disappearance of acid during their "formation" continues for ten or twelve days. At length, however, as the charging goes on the strength of the acid ceases to diminish and soon afterwards begins to augment. The increase continues until the maximum charge has been reached and abundance of oxygen and hydrogen gases begin to be discharged from the plates; that is to say, until the current is occupied exclusively, or nearly so, in the electrolysis of hexabasic sulphuric acid expressed by Burgoin in the following equation:—

$$\underset{\text{Sulphuric acid.}}{SO_6H_6} = \overbrace{\underset{\text{Sulphuric anhydride.}}{SO_3} + 3O}^{\text{Eliminated on + plate.}} + \overset{\text{Eliminated on − plate.}}{3H_2}.$$

Of course the sulphuric anhydride immediately combines with water and regenerates hexabasic sulphuric acid:—

$$SO_3 + 3OH_2 = SO_6H_6.$$

On discharging the cell the specific gravity of the acid continually decreases until the discharge is finished, when it is found to have sunk to about the same point from which it began to increase during the charging. Hence it is evident that during the discharge the lead sulphate, which was continuously decomposed in charging, was continuously reformed in discharging.

The chief if not the only chemical changes occurring during the charging of a storage battery, therefore, appear to be the following:—

1st. The electrolysis of hexabasic sulphuric acid according to the equation already given.

2nd. The reconversion of sulphuric anhydride into sulphuric acid.

3rd. The chemical action on the coating of the + plate.

$$\underset{\text{Lead sulphate.}}{SO_4Pb} + O + 3OH_2 = \underset{\text{Lead peroxide.}}{PbO_2} + \underset{\text{Hexabasic sulphuric acid.}}{SO_6H_6}.$$

4th. The chemical action on the coating of the negative plate:—

$$\underset{\text{Lead sulphate.}}{SO_4Pb} + H_2 + 2OH_2 = Pb + \underset{\text{Hexabasic sulphuric acid.}}{SO_6H_6}.$$

If I have correctly described these changes, the initial action in the charging of a storage cell is the electrolysis of hexabasic sulphuric acid, each molecule of which throws upon the positive plate three atoms of oxygen, and upon the negative plate six atoms or three molecules of hydrogen. Each atom of oxygen decomposes one molecule of lead sulphate on the positive plate, producing one molecule of lead peroxide, and one of sulphuric anhydride, the latter instantly uniting with three molecules of water to form hexabasic sulphuric acid.

The following are the chemical changes which I conceive to occur during the discharge of a storage cell:—

1st. The electrolysis of hexabasic sulphuric acid as in charging.

2nd. The reconversion of sulphuric anhydride into hexabasic sulphuric acid as already described.

3rd. The chemical action upon the coating of what was before the positive plate or electrode, but which now becomes the negative plate of the cell, that is to say, the plate from which the positive current issues to the external circuit:—

$$\underset{\text{Lead peroxide.}}{PbO_2} + H_2 = \underset{\text{Lead oxide.}}{PbO} + \underset{\text{Water.}}{OH_2}.$$

The lead oxide thus formed is immediately converted into lead sulphate:—

$$PbO + SO_6H_6 = SO_4Pb + 3OH_2.$$

4th. The chemical action upon the coating of what has now become the positive plate of the cell:—

$$Pb + O + SO_6H_6 = SO_4Pb + 3OH_2.$$

Thus in discharging, as in charging, a storage cell, the initial action is the electrolysis of hexabasic sulphuric acid. The oxygen eliminated on the positive plate reconverts the reduced metal of that plate into lead oxide, whilst the hydrogen transforms the lead peroxide on the negative plate into the same oxide, which in both cases is immediately converted into lead sulphate by the surrounding sulphuric acid, thus restoring both plates to their original condition before the charging began.

The real "formation" of the cell consists, I conceive, in the more or less thorough decomposition of those portions of the lead sulphate which are comparatively remote from the conducting metallic nucleus of the plate. Lead sulphate itself has a very low conductivity, whilst lead peroxide, and especially spongy lead, offers comparatively little resistance to the current, which is thus enabled to bring the outlying portions of the coating under its influence. It may be objected that, during the discharge, the work of formation would be undone; but probably, in the ordinary use of a storage battery, the discharge is never completed. Thus I have found that, in a small cell containing two plates 6″ × 2″, short circuiting with a thick copper wire for twelve hours was far from producing complete discharge, for on breaking this short circuit the cell *instantly* rang violently an electric bell with which it was previously connected. In ordinary discharges of "formed" cells, therefore, the lead sulphate on the positive and negative plates still remains mixed with sufficient lead oxide and spongy lead respectively to give it a higher conducting power than the sulphate alone possesses.

2. *Chemical Estimation of the Charge in a Storage Cell.*—No method has hitherto been known by which the charge in a storage cell could be ascertained without discharging the cell; but the results of the foregoing experiments indicate a very simple means of ascertaining the amount of stored energy without any interference with the charge itself. The specific gravity and consequent strength of the dilute sulphuric acid of a "formed" cell being known in its uncharged and also in its fully charged condition, it is only necessary to take the specific gravity of the acid at any time in order to ascertain the proportion of its full charge which the cell contains at that moment; and if the duty of the cell is known, the amount of energy stored will also be thereby indicated. In the case of the cell with which I have experimented, containing about seven quarts of dilute sulphuric acid, each increase of ·005 in the specific gravity of the dilute acid means a storage of energy equal to 20 amperes of current for one hour, obtainable on discharge.

I hope shortly to be able to express, in terms of current from the cell, the definite relation between the amount of energy stored and the weight of sulphuric acid liberated.

Chemical Society, March 30.—Anniversary Meeting.—Dr. Gilbert, president, in the chair.—The President presented his annual report, in which he gives a review of the progress of the Society from the commencement of its existence in 1841 up to the present time. The Society numbers 1247 Fellows, with an income of about 3000*l*. During the past year 70 papers have been read, and a discourse delivered by Prof. Dewar. Grants in aid of research have been made of 220*l*. 1775 copies of the *Journal* were printed during the past year. The library contains 6800 volumes, and a new catalogue will shortly be issued to the Fellows. In his address the President gives a most interesting *résumé* of the arrangements for chemical education and research on the American Continent. After the usual votes of thanks the following Officers, &c., were balloted for and declared duly elected:—President, W. H. Perkin, Ph.D., F.R.S. Vice-presidents: F. A. Abel, Warren De La Rue, E. Frankland, J. H. Gilbert, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, H. E. Roscoe, A. W. Williamson, A. Crum Brown, P. Griess, G. D. Liveing, J. E. Reynolds, E. Schunck, A. Voelcker. Secretaries: H. E. Armstrong, J. Millar Thomson. Foreign Secretary, Hugo Müller. Treasurer, W. J. Russell. Council: E. Atkinson, Capt. Abney, H. T. Brown, W. R. E. Hodgkinson, D. Howard, F. R. Japp, H. McLeod, G. H. Makins, R. Meldola, E. J. Mills, C. O'Sullivan, C. Schorlemmer.

Meteorological Society, March 21.—Mr. J. K. Laughton, F.R.G.S., president, in the chair.—The following gentlemen were elected Fellows of the Society: viz. Mr. G. T. Hawley, Dr. C. W. Siemens, F.R.S., Mr. C. Walford, F.S.S., and Col. H. G. Young. Dr. W. Köppen was elected an Honorary Member.—The paper read was notes on a march to the hills of Beloochistan, in North-West India, in the months of May to August, 1859, with remarks on the simoom and on dust storms, by Dr. H. Cook, F.R.G.S., F.M.S. These months may be considered as the summer of the hill-country of Beloochistan, though the natives expect the weather to change soon after the fall of rain, which takes place about the end of July and beginning of August. Compared with that of the plains, the climate is delightful. The actual heat is greater than in England, especially the intensity of the sun's rays, but the weather is less variable. Fruits and crops, as a rule, ripen earlier, and are not exposed to the vicissitudes of the English climate. The atmosphere is clear and pure, the air dry and bracing. Dr. Cook describes different kinds of dust-storms, and considers that they are due to an excess of atmospheric electricity. With regard to the simoom, which occurs usually during the hot months of June and July, it is sudden in its attack, and is sometimes preceded by a cold current of air. It takes place at night, as well as by day, its course being straight and defined, and it burns up or destroys the vitality of animals and vegetable existence. It is attended by a well marked sulphurous o'our, and is described as being like the blast of a furnace, and the current of air in which it passes is evidently greatly heated. Dr. Cook believes it to be a very concentrated form of ozone, generated in the atmosphere by some intensely marked electrical condition.—After the reading of this paper the Fellows inspected the exhibition of meteorological instruments for travellers, and of such new instruments as had been constructed since the last exhibition. In addition to the ordinary instruments designed for travellers, viz. barometers, thermometers, hypsometrical apparatus, compasses, artificial horizons, &c., some very interesting historical instruments used by celebrated travellers and explorers were exhibited, including those used by Dr. Livingstone in his last journey; by Commander Cameron during his journey across Africa; by Sir J. C. Ross in his Antarctic Expedition; by Sir E. Sabine, in his Arctic voyage, &c.

Zoological Society, March 20.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. Sclater called attention to the fact that a living specimen of *Macropus erubescens* (a species originally described from a single specimen living in the Society's Gardens) was in the Gardens of the Zoological and Acclimatisation Society of Melbourne.—Mr. Sclater laid before the meeting a set of the sheets of a new List of British Birds which had been prepared by a Committee of the "British Ornithologists' Union," and would shortly be published, and explained the principles upon which it had been constructed.—Prof. Huxley read a paper on the oviduct of the Common Smelt (*Osmerus eperlanus*), and took occasion to remark on the relations of the Teleostean with the Ganoid fishes. Prof. Huxley came to the conclusion that the proposal to separate the Elasmobranchs, Ganoids, and Dipnoans into a group apart from and equivalent to the Teleosteans was inconsistent with the plainest anatomical relations of these fishes.—Mr. G. A. Boulenger read a paper containing the description of a new species of Batrachian of the genus *Bufo* obtained at Yokohama, Japan, during the expedition of H.M.S. *Challenger*. The author proposed to describe it as *Bufo formosus*.—A communication was read from Mr. W. N. Parker containing some notes on the respiratory organs of *Rhea macrorhyncha*, and comparing these organs with those of the Apteryx and Duck.

Royal Horticultural Society, March 27.—Sir J. D. Hooker, K.C.S.I., in the chair.—*Sclerotia of Peronospora infestans*: Mr. W. G. Smith called attention to the fact that the so-called "sclerotia," described in a paper by Mr. A. Stephen Wilson, read at the last meeting, were observed and figured by Von Martius so long ago as in 1842 ("Die Kartoffel Epidermie") as Protomyces and by Berkeley as Tubercinia in his paper on the Potato Murrain, in the first volume of the *Hort. Soc. Journal*, 1846. They were subsequently figured by Broome in 1875, and by Prof. Buckman. Mr. G. Murray said that from his examination they often seemed to consist of the discoloured and disorganised contents of the cells, which they completely filled, though in Martius's drawing two or three were in one cell; Dr. Masters, however, noticed that they are often *outside* the cells and of an angular character, as if they had not assumed the form of the interior of a cell. The question was raised whether they might not have been expressed by the covering glass. Martius figured them with conidiferous threads proceeding apparently in abundance from them. Further investigation of their true nature was thought desirable.—*Abutilon* and *Hibiscus* "bigener": Dr. Masters described a very dark-flowered Abutilon which was said to be due to an original cross between *H. Rosa-sinensis* and *A. striatum*. The original plant was a dark-flowered seedling which was fertilised by Mr. George of Putney for two or three generations with the pollen of the Hibiscus, and though the character of the flower is that of an Abutilon, it has the truncated column and foliage of the Hibiscus, thus showing distinctly intermediate characters. In one plant the leaves were marked with a dark crimson spot. Hence it appears to be a true bigener, or cross between two distinct genera.—*Ivy-leaved Pelargonium Cross*: Mr. George sent some foliage of a cross between the ivy-leaved and a rough-leaved Pelargonium. Several showed a reversion to the peltate type, some assuming a funnel-shape or other irregular form, thus betraying its origin from *P. peltatum*.—*Orange-trees attacked by Mytilaspis citricola*, one of the Coccidæ: Mr. Maclachlan exhibited leaves and branches of oranges much injured by this insect from the Bahamas. He read a communication by Messrs. Dunlop and Roker communicated by the Governor to the British Government, requesting information. The insect was therein named *Aspidites Gloverii*. He made some remarks on the method of attack of the insect, and suggestions as to remedies to suppress it, such as washes and syringing with petroleum and the use of whale-oil soap.—*Solanum species*: Sir J. D. Hooker read a communication from Mr. Lemmon, of Oakland, California, upon the discovery of three species or varieties of Solanum bearing tubers, from the borderland of Arizona and Mexico:—"We found them first," writes the author, "on the cool northern slopes of the high peaks [of the Huachuca range]; then afterwards, where least expected, invading the few rudely cultivated gardens of the lower foothills. One kind is called *S. Jamesii*, Tor., in the "Survey of the Mexican Boundary." This has white flowers and tubers. Another was *S. Fendleri*, Gr. It has smaller purple flowers and flesh-coloured tubers. This Dr. Gray lately concludes to be but a variety of the old Peruvian potato, and he calls it *S. tuberosum*, var. *boreale*. The third form or species found at 10,000 feet altitude has mostly single orbicular leaves, one or two berries only to the umbel, and small pink tubers on long stolons, growing in loose leaf-mould of the cool, northern forested slopes. . . . I have great faith in the successful raising of one of these species (or varieties) to a useful size, for the following reasons:—1. While the *S. tuberosum*, var. *boreale*, bears long stolons and but a few tubers, the other kind, *S. Jamesii*, makes many short stolons terminated by four to eight large, round white tubers. 2. While the first kind has been partially tried and then given up, the latter species is known to have become enlarged to the size of domestic hens' eggs during the accidental cultivation of three years in the embanking of a rude fish-pond."

EDINBURGH

Royal Society, March 19.—Prof. Maclagan, vice-president, in the chair.—Mr. Sang read a paper on the impossibility of inverted images in the air, in which he discussed the conditions as to density necessary for such an effect, concluding that these atmospheric conditions were so unstable as to make it physically impossible for clear images to be formed. The famous observation by Vince of the erect and inverted images high up in air was, he maintained, simply the case of a vessel and its reflection in the sea, which was so calm as to be indistinguishable from the sky—the *apparent* horizon being the margin of a ruffled portion of the surface between the true horizon and the observer.—Prof. Tait communicated a note on the thermoelectric positions of pure rhodium and iridium, specimens of which had been supplied him by Messrs. Johnson and Matthey. The lines of these metals on the thermoelectric diagram were found to be parallel to the lead line, that is, according to Le Roux, the Thomson effect is *nil* in them. Unfortunately the lines are too close to be of any practical use as a thermoelectric thermometer.—Dr. Christison gave the results of the observations on the growth of wood in deciduous and evergreen trees, which had been begun by the late Sir Robert Christison in 1878, and continued by himself since Sir Robert's death. It appeared that the evergreen trees began their rapid growth much earlier in the year than the deciduous trees, and stopped sooner. Hence the reason why the variations in growth in successive years did not follow the same law in these two classes—an early winter affecting the deciduous trees, a late winter the evergreen. The effect of wet seasons was also indicated, the deciduous trees being apparently more influenced.—Mr. Buchan read a paper on the variation of temperature with sunspots. The comparison was not a direct one, but was based upon the well-known phenomenon of the diurnal barometric oscillation viewed in relation to the amount of water vapour in the air. From the observations of the *Challenger* Expedition, Mr. Buchan had concluded that this diurnal variation over the open sea was not the result of changes of surface temperature (for these were very small), but was to be referred to the direct heating effect of the sun upon the air, or more strictly upon the water vapour in the air. This view was supported by the fact that over the sea the diurnal variation of pressure was greatest where most vapour was; whereas the contrary held over the land, the temperature of which varied greatly during the day, and the more so when the air above was drier, as more heat then reached the earth. In other words, the increase of moisture in the air increases the barometric oscillation over the sea and diminishes it over the land; and hence it seemed probable that the discussion of these daily oscillations in sun-spot cycles might lead to some definite result. The long-continued observations at Calcutta, Madras, and Bombay were combined in this way, and yielded a remarkable result—there being a well-marked maximum of barometric diurnal oscillation half way between the minimum and maximum sun-spot years, and a minimum half way between the maximum and minimum years. The averages were taken for the five dry winter months, and the effects were explained as due to the accumulated water vapour in the upper southerly winds that exist over India during these months. When the rainfall on the southern slopes of the Himalayas was similarly treated—which rainfall is of course due to the arresting of these upper moist currents—the analogous fact was brought out, viz. minimum rainfall at times of maximum barometric oscillation and *vice versâ*.

DUBLIN

Experimental Science Association, March 13.—On Ayrton and Perry's voltmeter, by Prof. Fitzgerald.—On an experiment on the resonance of flames, by H. Maxwell. A vibrating tuning fork when held in a gas or candle flame, or in the heated current of air above, was shown to have its note greatly strengthened. A current of unignited gas produced no perceptible strengthening of the note.—A thermal galvanoscope, by C. D. Wray. A method of showing to an audience the expansion of a wire under the heating influence of a current of electricity.—On a thermometer that can be read by telegraph, by J. Joly. An arrangement whereby the level of the mercury in a thermometer can be read by reckoning the number of contacts made with a battery in the home station. Suitable mechanism on the thermometer causes a wire to advance down the open tube of the thermometer, by a known minute distance, at each passage of the current. On reaching the mercury, a current passes to a galvanometer in the home station.

SYDNEY

Linnean Society of New South Wales, January 31.—C. S. Wilkinson, F.G.S., president, in the chair.—The following papers were read:—On a new form of mullet from New Guinea, by William Macleay, F.L.S., &c. This is a description of a very remarkable freshwater fish from the interior of New Guinea, allied to Mugil, but constituting a new genus to which the author gives the name of *Æschrichthys*.—By J. J. Fletcher, M.A., B.Sc. The second part of his paper upon the anatomy of the urogenital organs in females of certain species of Kangaroos.—On remains of an extinct Marsupial, by Chas. W. De Vis, B.A. This is a very careful description of a number of bones found together and evidently of the same individual, by Mr. Henry Tryon, in Gowrie Creek, Darling Downs. The bones and teeth point to some bilophodont form, showing affinity with *Macropus* and *Palorchestes* on the one hand, and with *Nototherium* and *Diprotodon* on the other.—Contributions to the ornithology of New Guinea, by E. P. Ramsay, F.L.S., &c. This contained a complete list of the birds recently brought by Mr. Goldie and others from the south-east part of the island.—On a new species of Tree Kangaroo from New Guinea, by the same author. This differs from *Dendrolagus venustus* in some particulars, and is named after the Marquis Doria. A new Rat (*Hapalotis Papuanus*) was also described.—On some habits of *Pelopæus lætus* and a species of *Larrada*, by Mr. H. R. Whittell.—Mr. Whittell also read a short paper on the voracity of a species of *Heterostoma*. He had observed one of these centipedes in the act of eating a live lizard. The aggressor, evidently finding his victim too powerful for his unassisted strength, had ingeniously taken a double turn with the posterior portion of his body around a small stem which was found conveniently at hand, and so was enabled to continue his meal without interruption.

BERLIN

Physical Society, March 2.—Prof. Kirchhoff in the chair.—Dr. König reported on two optico-physiological researches, which he had carried out in consequence of his optical studies with the leucoscope. In the first he has, with the aid of a special apparatus, examined a number of colour-blind persons as to the position in the spectrum of their so-called "neutral" point. According to the Young-Helmholtz theory, it is known, there are three primary colours (red, green, and violet), each of which produces its special colour-sensation, while all combined give the impression of white. The sensibility for the three primary colours is so distributed over the spectrum that their curves in great part coincide on the abscissa of wave-lengths, and therefore mixed colour-sensations occur everywhere, while the maxima of the separate curves occur at the places of brightest red, green, and violet respectively. In the case of the colour-blind one curve is wanting, and the two remaining ones have therefore a point of section where their ordinates are the same. Hence the eye must at this part have the impression of white or grey. For finding this neutral point in the spectrum, an apparatus served, in which the telescope of a spectroscope was so arranged with regard to the non-refringent angle of the prism that the spectrum took up only half of the field of vision, while the other half was occupied with the image of the white-painted ground-surface of the prism. Instead of the eyepiece there was another slit in the telescope, in which one saw only a small section of the spectrum; by micrometric displacement of the collimator of the spectral apparatus any part of the spectrum could be brought on the slit. Now at a particular part of the spectrum the colour-blind person saw both halves of the field of vision white, while the person with normal vision saw the part of the spectrum in question in its normal colour, and so could determine the wave-length at which the neutral point of the colour-blind person occurred. Changes of light-intensity displaced the neutral point; hence in comparative measurements care must be taken to have the same intensity in the source of light. Such measurements were made by Dr. König with great precision on nine colour-blind persons, and it appeared that the neutral points are situated between about 491 and 500 millionths of a millimetre, and (what is of special interest theoretically) that the mean values of the separate observations with different colour-blind persons were not equal, but varied in a pretty regular series between the two terminal values. According to the common view that colour-blindness depends on the disappearance of one of the normal three curves of colour-perception, the position of the neutral point as point of section of the two curves present must be always the same, and for the red and the green blind must be at two quite determinate points of the spectrum. As the experiments have yielded a different result in persons, two of whom were red-blind, and seven green-blind, Dr. König believes that the essence of colour-blindness consists not in the absence of one curve, but in the displacement of two curves on one another, which may be more or less complete, and so produces the different degrees of colour-blindness observed. In the second investigation Dr. König sought to determine the two remarkable points of section of the three curves that occur, according to the Young-Helmholtz theory, in normal colour-perception. From the researches of Prof. von Helmholtz on the wave-lengths of the complementary colours, and from those of Clerk Maxwell on colour-mixtures, appear values for these points of section which agree pretty well. The same values, approximately, are reached by the researches of several ophthalmologists on the places of quickest change of colour in the spectrum. Dr. König tried to determine the first section point by making the violet curve disappear through the taking of santonin, and when he had thus made himself temporarily violet-blind, he determined his neutral point, the point of section of the red and the green curve. All these determinations and theoretical considerations led to pretty much the same values for the points of section, and the first point is situated not, as is often supposed, in the yellow, but in the blue, between the Fraunhofer lines E and b_1, and nearer the latter.

Paris

Academy of Sciences, March 26.—M. Blanchard in the chair.—The following papers were read:—On an objection of M. Tacchini relative to the theory of the sun in the *Memorie dei Spettroscopisti Italiani*, by M. Faye. Having observed the eruptions accompanying a spot to be intermittent and of brief duration, M. Tacchini thinks this fact against the theory of the spots being due to cyclonic movements. M. Faye says this is as if, on seeing the water-jet of a force-pump go down, one maintained that the pump did not exist.—Contribution to the study of stamping and of the "prows" it produces, by M. Tresca.—On the motion and deformation of a liquid bubble which rises in a liquid mass of greater density, by M. Resal.—Note on the preparation of oxide of cerium, by M. Debray.—On the reading of a report by M. d'Abbadie on his transit expedition to the island of Haiti, the president expressed the felicitations of the Academy (concern had been felt on account of the prevalence of yellow fever).—Addition to preceding communications on continuous periodic fractions, by M. de Jonquières.—Character by which one may perceive if the operation indicated by

$$\sqrt[2m+1]{a\sqrt{v} \pm b\sqrt{wi}}, \text{ or by } \sqrt[2m]{a \pm b\sqrt{vwi}},$$

may be effected under the form $\alpha\sqrt{v} \pm \beta\sqrt{wi}$, m designating a positive whole number, v and w positive rational numbers, and a and b, α and β any rational numbers; method of effecting this operation, by M. Weichold.—On a spectroscope with inclined slit, by M. Garbe. He described to the French Physical Society on March 2 an arrangement similar to M. Thollon's.—Observation on the figures of consumption of zinc given by M. G. Trouvé for his bichromate of potash batteries, by M. Regnier. He points out a difference between the effective and the theoretical expenditure.—Heat of formation of glycolates, by M. de Forcrand.—Action of sulphur on oxides, by MM. Filhol and Senderens. Sulphur acts on alkalies in the dissolved state less and less easily the greater the dilution.—On the action of different varieties of silica on lime water, by M. Landrin. Hydraulic silica, gelatinous silica, and soluble silica absorb lime water more or less rapidly, but in all cases the absorption finally varies, for one equivalent of silica, between the limits 36 and 38. The formula $3SiO_2,4CaO$, requiring for 30 of silica 37·3 of lime, thus fairly expresses the limit towards which those phenomena tend.—On the hydrate type of neutral sulphate of alumina, by M. Marguerite-Delacharlonny.—On the production of bromised apatites and Wagnerites, by M. Ditte.—Researches on crystalline phosphates, by MM. Hautefeuille and Margottet.—On various effects of air on beer yeast, by M. Cochin. It is only some time after the glucose solution has penetrated, by endosmose, the membranous envelope of the yeast cells, that fermentation commences. Sometimes (yeast aërated) the sugary liquid simply penetrates into the yeast, the proportion of sugar outside continuing undiminished; sometimes (yeast deprived of air) the sugar is absorbed in larger quantity by the yeast and the liquid outside impoverished. It is within the cell that the sugar is transformed. Probably air attenuates ferments as it does virus.—Determination of extractive matters and of reducing power of urine, by MM. Etard and Richet. This determination is made with bromine; which in acid solution attacks the uric acid and the extractive matters. The reducing power of urine varies much in different individuals, but little in one individual.—The perception of colour and the perception of form, by M. Charpentier. Luminous rays have two distinct actions on the visual apparatus—one gives rise to the rudimentary perception of light and is distributed pretty equally over all points of the retina; the other is more efficacious on the centre of the retina, giving rise, on the one hand, to the sensation of colour, on the other to the distinction of multiple luminous points.—Note on the adherence of a frontal tumour with the yolk, observed in a cassowary which died in the egg at the moment of hatching, by M. Dareste.—New observations on the dimorphism of Foraminifera, by MM. Munier-Chalmas and Schlumberger.—Attempt at application of M. Faye's cyclonic theory to the history of primitive meteorites, by M. Meunier. He considers that chondrites are to rocks of gaseous precipitation what iron grains, &c., are to rocks of aqueous precipitation. They testify to eddies in the generating medium, to photospheric cyclones.—On shocks of earthquake observed in the department of La Mayenne, by M. Faucon. These were felt about 3 p.m. on March 8. Three considerable trepidations occurred in a few seconds.—M. Decharme described a method of preserving and reproducing crystalline forms of water. A horizontal glass plate at a low temperature is covered with a thin layer of water mixed with minium; particles of the minium are involved in the formation of ice. Ulterior fusion and evaporation leave the minium in position.

Vienna

Imperial Academy of Sciences, February 15.—C. v. Ettingshausen, contributions to the knowledge of the Tertiary flora of Australia.—F. Brauer, to nearer knowledge of the Odonatæ, genera Orchithemis, Lyriothemis, and Agrionoptera. — On the systematic position of the genus Lobogaster, Pil., by the same.—S. Tolver Preston, a dynamic explanation of gravitation.—On the possibility of explaining past changes in the universe by the action of natural laws now active, by the same.—E. Heinricher, contributions to the teratology of plants and morphology of flowers.—P. Pastrovich, on Reichenbach's picamar; on cœrulignol, Reichenbach's oxidating principle.—A. Tarolimek, on the relation between tension and temperature of saturated vapour.

March 1.—W. Biedermann, contributions to general nerve and muscle physiology (eleventh communication); on rhythmic contractions of striped muscles under the influence of constant currents.—V. Graber, fundamental experiments on the light and colour sensibility of eyeless and blinded animals.—P. R. Handmann, on a very useful filling of the zinc-carbon battery.

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