THURSDAY, JULY 27, 1893.

THE ROTHAMSTED JUBILEE.

ON Saturday next a large gathering of scientific men will assemble in the village of Harpenden to do honour to two investigators who have just completed fifty years of joint labour.

The occasion is unique. It can have happened but seldom that two men have continued their joint scientific investigations for a period like the present; but there are other circumstances, apart from this, which mark the event about to be celebrated as one of exceptional interest. The Rothamsted agricultural experiments are indeed a piece of work of which England may well be proud. They form a splendid example of what is sometimes accomplished amongst us by purely individual effort. The extensive series of costly experiments, carried out on a large scale both in the field and in the laboratory, and with results of national importance, has been maintained for more than fifty years at the sole expense of one man. Nor is this all. Sir J. B. Lawes has made provision for the continuance of these investigations. The laboratory and the experimental fields, with £100,000, have been placed in the hands of trustees, and the future management of the investigations has been entrusted to a committee, the members of which are elected by various scientific societies.

But it is not only as a striking example of individual zeal and munificence that the Rothamsted agricultural station is remarkable, it is equally so if we regard the character of the work performed. Many of the most important problems connected with agriculture can only be satisfactorily studied by actual experiments in the field; such experiments require to be carried out on a large scale and continued for many years. Boussingault was, we believe, the first who sought to ascertain the chemical statistics of agriculture by a quantitative examination of the actual crops of the farm, and by a study of the constituents of soil, of manure, and of rain-water—the various factors which determine the amount of the harvest. But if the work of Boussingault stands first in order of time, the work of Lawes and Gilbert at Rothamsted immediately follows it, and has been continued for such a much longer series of years, and developed in so many new branches of inquiry, that it is to Rothamsted that the agriculturist has long looked for information concerning the fundamental facts of agricultural chemistry.

The field experiments at Rothamsted are peculiar to the place; in very few of the now numerous agricultural stations in foreign countries has systematic work of this kind been attempted; in none has the work been so extensive and so long continued. No less peculiar to Rothamsted has been the laborious investigation into the composition of oxen, sheep, and pigs in various stages of fattening, and into the chemistry of the fattening process. Of the laboratory investigations we may mention the more recent inquiry into the causes and conditions of the production of nitrates in soil, and respecting the quantity of nitric nitrogen in soils of various history, and in drainage and well waters. But we must not here attempt an enumeration of published Rothamsted work, which, according to the last report, has furnished the matter for 125 papers.

Rothamsted is by much the oldest of existing agricultural stations. The earliest German experimental station was founded in 1852, the earliest in the United States in 1875. The first agricultural experiments of Mr. Lawes seems to have been made in 1837; in this and the two following years he tried numerous experiments on farm crops grown in pots. His trials in the field commenced in 1840. In 1843 he was fortunate in securing the services of Dr. J. H. Gilbert, a former pupil of Liebig's, who henceforth took the superintendence of the chemical part of the investigations. Dr. Gilbert has devoted his life to the conduct of the Rothamsted experiments, and the valuable results which have been obtained are largely due to his untiring energy, and to the method and order which his character has impressed upon the work. The jubilee to be celebrated this week is reckoned from the year when Dr. Gilbert began to take a share in the work; the same year also saw the first of the experimental wheat crops sown in Broadbalk Field, which, at the present time, bears its fiftieth successive crop, having grown wheat without intermission during half a century. Numerous honours have been conferred on Messrs. Lawes and Gilbert in the course of their long career. Our Universities have bestowed on them degrees. The Royal Society in 1867 awarded them a royal medal. The Society of Arts has during the current year decided to present them with its Albert Medal. Foreign societies and academies have elected them members of their body. In 1882 Mr. Lawes received a baronetcy from the Queen.

The jubilee commemoration of the present week took its rise at a meeting held in the rooms of the Royal Agricultural Society on March 1, the Prince of Wales occupying the chair. A committee of distinguished men, with the Duke of Westminster as chairman, and Mr. Ernest Clarke, Secretary to the Royal Agricultural Society, as secretary, was appointed to carry out the scheme. The celebration on Saturday will consist, as the readers of NATURE are already aware, in the unveiling of a granite memorial erected in front of the laboratory; in the presentation of congratulatory addresses to Sir J. B. Lawes and Dr. Gilbert; and in the presentation to Sir J. B. Lawes of his portrait, by Hubert Herkomer, R.A. It is hoped that the Right Hon. Herbert Gardner, M.P., the Minister for Agriculture, will preside.

The laboratory, in front of which the celebration is to take place, is itself a testimony to the appreciation with which the labours of Lawes and Gilbert have been regarded. It is not the laboratory originally employed in the early years of the experiments; this was a barn which had been fitted up for chemical work, and has long ago been pulled down. The present laboratory was built and presented to Sir J. B. Lawes in 1855 by a number of agriculturists, at a time when agriculture was a more profitable pursuit than it is at present. Since then the needs of the work have grown, and a large storehouse for soil and crop samples has been erected by the side of the new laboratory.

Of greater interest to most visitors than the laboratory is the old manor of Rothamsted. This charming red brick building dates from 1470, though, like most old buildings, it has since undergone alteration and enlargement. This manor house has been the home of Sir J. B. Lawes' ancestors since 1623. The history of the family is remarkable. It was in 1564 that Jacques Wittewronge came to England from Flanders in consequence of the religious persecution then prevailing. The family first resided in Buckinghamshire; they afterwards purchased the manor of Rothamsted. Sir J. B. Lawes is a descendant of this family through the female line.

In the manor house of Rothamsted Sir J. B. Lawes was born in 1814. His whole life has been one of great activity; probably few men have accomplished more work. Though for many years a hard-working man of business, he has always loved a retired country life, and has been rarely seen at public meetings. A keen observer and an untiring experimenter, he has given his whole mind to the problems of agriculture, while his great practical sagacity has enabled him to grasp at once the real bearing and importance of each new fact. Probably no one has taken a more practical and wide-reaching view of agricultural questions than Sir J. B. Lawes. When the present century is concluded, the work of Lawes and Gilbert at Rothamsted will be reckoned among the prominent achievements deserving a grateful record.

THE ORIGIN AND DEVELOPMENT OF MUSIC.

Primitive Music: an Enquiry into the Origin and Development of Music, Songs, Instruments, Dances, and Pantomimes of Savage Races. By Richard Wallaschek. (London: Longmans, Green, and Co., 1893.)

MR. WALLASCHEK has not only compiled with laborious care what appears to be an exhaustive account of the music of so-called savage races, but has based upon the foundations thus laid an able and interesting discussion on the origin and development of music. It is with the latter rather than the former part of his work that I propose to deal in this notice.

The author is led by his researches to regard rhythm as the primitive and primary constituent of music, while melody was in the primitive state, and has remained, secondary and accessory. Harmony is not to be looked upon as a comparatively recent invention among European races. "As soon as music passes the mere rhythmical stage the lowest races in the scale of man begin to sing in different parts in intervals as well as with a bass accompaniment." The order of development therefore is, first rhythm, and then, possibly coeval one with the other, melody and harmony. With what then is the rhythm of primitive music associated? With the rhythm of the dance. If I understand the author rightly this association is, in his opinion, an invariable one in the origin of music. Now, "in dance-music the idea is to excite the performer and to fatigue him even to exhaustion. The musical dance-chorus is of a social character; music keeps the company together and enables them to act simultaneously." I quote here from the author's summary, which is no doubt somewhat condensed and elliptical. One can hardly suppose that "fatigue even to exhaustion" was part of the primary "idea" (understanding by this word aim and object) of the dance. Would it not have been better to say that a part of the "idea" was to test and tax the powers of endurance of the performers? Be this as it may, war, the chase, and sexual passion afford the underlying motives of that emotional excitement which finds its expression in the rhythm of the dance; and thus this rhythm becomes most intimately bound up with practical life-preserving and life-continuing activities, or, in other words, with activities which are distinctly of natural-selection value. The large share taken by women in the dance and primitive music enables them to contribute not ineffectually towards the success of the tribe in its struggle with other tribes.

"If it be asked whence the sense of rhythm arises, I answer," says the author, "from the general appetite for exercise. That this occurs in rhythmical form is due to sociological as well as psychological conditions. On the one hand there is the social character of primitive music, compelling a number of performers to act in concert. On the other, our perception of time relations involves a process of intellection," and hence an appreciation of time, order, and rhythm. I would suggest that the psychological basis of the "sense of rhythm" might be found in experiences more primitive than any process of intellection—in the organic rhythms of our daily life. We cannot walk nor breathe except to rhythm; and if we watch a little child we shall obtain abundant evidence of rhythmic movements. This I should have placed first; and then the concerted rhythms of social activities. "Whence," asks Mr. Wallaschek, "does the general desire for exercise arise? Mr. Herbert Spencer's theory affords," he replies, "the most valid explanation. It is the surplus vigour in more highly evolved organisms, exceeding what is required for immediate needs, in which play of all kinds takes its rise; manifesting itself by way of imitation or repetition of all those efforts and exertions which were essential to the maintenance of life (*e.g.* the war-dance)." In explanation of the term "surplus vigour" the author does well to point out that this is not meant to imply a surplus beyond the needs of the organism at any time of its life, but a temporary surplus beyond its needs in times of unmolested peace and plenty.

While accepting Mr. Spencer's general theory of surplus vigour, Mr. Wallaschek is not prepared to accept the speech-theory of the origin of music. "Whereas Mr. Spencer," he says, "seems to think that musical modulation originates in the modulations of speech, I maintain that it arises directly from the rhythmical impulse." Without presuming to decide between Mr. Herbert Spencer and Mr. Wallaschek, I venture to point out how much depends upon the exact definition of "music" and of "speech." Mr. Wallaschek, as we have seen, regards primitive music as essentially rhythm without necessary association with either melody or harmony. It is a mere tone-rhythm in

association with dance-rhythm. Whether to such tone-rhythm the term "music" can be satisfactorily applied, I am myself inclined to question. But that is another matter. We are bound to accept for the purposes of his argument the definition which an author sets forth. All that Mr. Spencer has written on the subject, however, leads us to suppose that for him music includes melody, or at least cadence. And I take it that in his speech-theory it was the melody or cadence of music that he specially had in view. Now "speech" may either mean intentional suggestion by means of vocal sounds, or such suggestion by means of vocal sounds rendered articulate and ordered in propositions. Taking the former and broader meaning, it appears to me that the vocal sounds associated with the dance must be regarded as having suggestive value to those who are acting in concert, and as possessed of rhythmic import; and that, further, from these vocal sounds arose the melodic and harmonic elements of music. Personally, I should advocate the more restricted use of the word "speech," and should prefer to say that both music (including melody) and articulate speech are of vocal origin. And this, I take it, comes very near, not only to Mr. Wallaschek's own view, but also to that of Mr. Spencer against whom he is arguing. The association of these vocal sounds with the concerted activity of the dance is quite in line with the suggestion of Noiré, adopted by Prof. Max Müller, that the origin of speech is to be sought in the vocal sounds uttered during the performance of common social actions.

There are many other points in Mr. Wallaschek's book to which I should be glad to draw attention did space permit. His discussion of the origin of the diatonic scale is of interest and value. He is on firm ground in his contention that primitive music is associated with life-preserving and life-continuing activities, and was thus in its early phases fostered and developed by natural selection. This few evolutionists would care to question. But concerning the development of music, *as an æsthetic activity*, he does not suggest anything very definite. He holds that there is nothing in the history of musical development to justify a belief that the inheritance of acquired faculty has been a factor in the process; and here I think he is right so far as definite evidence goes. He also holds that the great musician is a man of power who has devoted his faculties to music, and who would have been great as a painter or as a poet had circumstances led him to devote his faculties to these arts. And here again I believe that he is right. But the question is, What has guided musical development along the special lines that it has taken in Europe? I do not think that Mr. Wallaschek will contend that the guidance has here been that of natural selection. But guidance there has been. No doubt in this as in other matters of art, man has been giving objective expression to his ideals. But what has led the ideals to take the form they have taken? This is one of the most difficult problems presented by the psychology of æsthetics; and it no doubt lies somewhat beyond the field of primitive music on which Mr. Wallaschek has given us a work of real merit and value.

C. LLOYD MORGAN.

EARLIER RECOLLECTIONS OF MARIANNE NORTH.

Some Further Recollections of a Happy Life, selected from the Journals of Marianne North, chiefly between the Years 1859 *and* 1869. Edited by her sister, Mrs. John Addington Symonds. Post 8vo, pp. 316, with two portraits and a sketch. (London and New York: Macmillan and Co., 1893.)

THIS volume might very appropriately have borne the title of "Earlier Recollections," inasmuch as it describes the life of Marianne North antecedent to the period comprised in the two volumes previously before the public. On this point Mrs. Symonds says in her preface: "When publishing the former volumes of my sister's autobiography, it was thought wiser to cut out some of the earlier chapters describing well-known ground, in order to make room for those more distant journeys by which her name had become known to the to the world. But the unexpected success which that book met with induces me now to add those first European journeys, with one through Egypt and Syria."

It is probable that these sketches of travel in Europe, Egypt, and the Holy Land, from twenty-four to thirty-four years ago, will appeal to an even wider range of readers than the accounts of Miss North's later journeys to the furthermost parts of the earth, after she had become so widely known as a traveller and a painter. The same freedom in style and criticism pervades this as well as the former volumes. Briefly, it may be described as a rapid and graphic narrative of the incidents of travel, interspersed with lively observations on peoples and places, on plants and animals, and on the physical features of the countries traversed, with here and there historical allusions and reflections. The earlier journeys, that is from 1859 to 1869, were made in the company of her father; and her sister, who has edited these recollections of long ago, was also of the party up to 1867, and therefore well qualified for the task. The first trip was to the Pyrenees and Spain, by way of Jersey, St. Malo, Rennes, Tours, Bordeaux, and Pau. A stay of a month was made at Luchon, where Miss North made her first attempt at landscape painting. Thence they went to Barcelona, Tarragona, Valencia, Madrid, Toledo, Granada, Malaga, Seville, and Cadiz, and home by sea. This trip occupied nearly six months, and is described in less than thirty pages! In fact, the pace is tremendous, though the travelling in Spain was nearly all by diligence, which was very exciting if not absolutely dangerous. However, only the main incidents are touched upon, and the reader finds himself in a fresh place on every page. In 1865 and 1866 Egypt and Palestine were visited. Even at that period Miss North painted very assiduously, but a painting of doum and date palms, on the Nile above Philæ, is the only one in the North Gallery at Kew of that date. After the death of her father, in 1869, Miss North continued to travel, in order to forget her loss; first visiting Mentone and then Sicily. Much of her time was occupied in painting, though only one picture, the Papyrus growing in the Ciane, near Syracuse, is in the collection at Kew. All the rest, with one other exception alluded to above, are the work of her more distant journeys of later date. But all persons who have read

the entertaining and interesting descriptions of the longer journeys will be anxious to possess the present volume, and will, we predict, not be disappointed with the contents. Should it, however, run to a second edition, the words and phrases from various foreign languages scattered through the book might be expunged or corrected. It is rather odd to find a priest or monk designated as "Signor Cannonico"; and an extra syllable in Beleuchtung does not improve it. There is, too, an unfortunate slip in the preface and on page 133, Elephantine Island being referred to as the Island of Elephanta. W. B. H.

OUR BOOK SHELF.

Elements of Psychology. By James Mark Baldwin, Professor Elect in Princeton College. (London: Macmillan and Co., 1893.)

UNDER the above title Prof. Baldwin has written a shorter text-book which, as he states in the preface, differs from his larger work, the *Handbook of Psychology* (reviewed in these pages vol. xliii. p. 100, and vol. xlvi. p. 2) mainly in its omissions. Like its larger predecessor, this book deals largely with "apperception" regarding, erroneously as we think, the selective synthesis observable in mental products as something wholly different from anything which is to be found in other departments of natural knowledge. "In the physical world," he says, "we find no such unifying force as that known in psychology as the activity of apperception." Although there is much in this work, as in its predecessor, with which we are in hearty but friendly disagreement, it appears to us to possess the great merit of giving abundant evidence of independent thought and treatment. It will, in the hands of senior students, stimulate them to thought and criticism—such criticism as the teacher who is in earnest welcomes like a breath of keen fresh air. The chief fault of the book is that its pages are somewhat unduly crowded with details. C. LL. M.

An Introduction to the Study of Geology. By Edward Aveling, D.Sc. (London: Swan Sonnenschein and Co. 1893.)

DR. AVELING has compiled a volume better, in many respects, than any of its kind. His arrangement of matter has much to commend it, and his descriptions are of the concise character regarded with favour by those who incline to a pabulum consisting of concentrated essence of knowledge. The book is another of that large class "specially adapted for the use of candidates for the London B.Sc. and the Science and Art Department Examinations." Intending examinees would do well to obtain it, but the student who loves geology for its own sake will hardly find the contents to his liking.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Publication of Physical Papers.

AS most people seem afraid to enter on this discussion, it is appropriate for others to rush in. I have not, however, anything very much to say, except (1) that it seems to be a subject which in its intersectional aspects is suited to oral discussion at a meet- of the British Association, and (2) that if the *Beiblätter* were regularly and intelligently translated a good deal of the necessary physical abstracting would *ipso facto* be done.

Abstracting on a large scale is difficult work, and the English genius scarcely runs in that direction. It seems to me a pity for a greater number of competent persons to be engaged on it than is really necessary, and if the Germans are good enough to do it for the world, why should we not recognise their work and utilise it to the utmost?

It will be answered, so we do; everyone sees the *Beiblätter*. Yes, and I suppose about half a dozen effectively glance through it. Not everyone is capable of taking in a page of German at a glance, as one can English, and, for myself, I find that what I have half-read in a foreign tongue has a fatal facility for slipping from the memory.

I need not labour the point, it is simply this—that whereas a weighty paper of known and conspicuous importance in one's own object can, if necessary, be worked at and utilised in almost any ordinary language, papers of uncertain value or of only approximate interest must be skipped altogether unless they can be skimmed; and that the skimming process in a foreign language is impossible to all but a few favoured physicists, whatever may be the case with chemists.

If an English edition of the *Beiblätter* were regularly published, the only abstracts that would remain to be done by us would be the contents of Wiedemann's *Annalen* and possibly of a few American or provincial publications.

But there are other questions besides that of abstracts; and chief among them is the question of central publication of all the English papers of importance which at present are difficult to procure.

These occur mainly in connexion with the Societies of Dublin, Cambridge, and Edinburgh. Few other Societies in the British Islands claim or possess a monopoly over papers presented to them. Nearly all except these three are, I suppose, now used chiefly for contemporaneous or *ad interim* publication, and any serious results are communicated by the author to some central organ. If that is not so it ought to be so. If an author has a good result which he will not publish, he can hardly be compelled. It ought, however, to be clear that mere printing in a half-known local journal is not proper publication at all; it is "printing for private circulation." Biologists are, I am told, given to err in this direction, each small society pluming itself on publishing memoirs in order to receive "exchanges," a ghastly and polyglot form of literature which may be catalogued but can hardly be read. However, biologists are doubtless the best judges of their own procedure, and what is suited to a copious and readily illustrated subject is not likely to be well adapted to physics.

Coming to the really central organs (whether general or special), the Transactions and Proceedings of the Royal Society, the *Philosophical Magazine*, and NATURE; most British and Colonial physicists can see them without trouble, and the *Phil. Mag.* is seen all over the world. Merely a few slight changes are needed in connexion with these organs. The Proceedings are largely a journal of the doings of the Royal Society, and as such are not specially edifying to outsiders. In consequence of this, perhaps, and also in consequence of the multifarious nature of the subjects treated simultaneously, the papers included therein do not get widely known. The Transactions are all published as separate memoirs, so that there need be no difficulty for an isolated worker not a Fellow to procure a copy, if the contents are freely advertised. But I would suggest that the cost of these separate copies and of each number of the Proceedings, is much too great. As one not at all behind the scenes, I am ignorant of the reasons for this high price, but I should think it might be a proper expenditure of some of the Society's wealth if their publications could by a considerable reduction in price, even to a nominal figure, be made much more widely available.

For most societies the method of publication invented, or at any rate adopted, by the Physical Society of London, seems to me well worthy of imitation. Until this is done, there remains the question of making the valuable papers which occasionally, or perhaps frequently, appear in NATURE or other weeklies, in the Transactions of the Cambridge, Dublin, and Edinburgh Societies,[1] and sometimes in the Proceedings of the Manchester and other provincial societies, more accessible to foreigners and incidentally to ourselves. This could be done by central reprinting, either in a new special publication, or in some extra

[1] I do not specifically mention the semi-technical societies, such as the Institution of Electrical Engineers, though often it is difficult to draw the line, and some of their papers, too, might be included.

volume of an already existing publication. I feel that it ought to be in some neutral, or non-society journal, to avoid arousing jealousy. If either the Royal or the Physical Society could take the matter up and arrange for, say, an extra half-yearly number or an extra annual volume of the *Phil. Mag.*, the thing could be done.

If they could also at the same time arrange for a prompt translation and republication of important foreign papers, many of us would be grateful; cash has hitherto been the main difficulty, but perhaps with the abundant funds at present available across the Atlantic, we may hope for something large and cosmopolitan in this direction before long from our co-linguists there. I commend this to the notice of the energetic secretary of the Smithsonian Institution. Everything tending to mitigate the miserable evils of the confusion of tongues would be eminently welcome, and whenever the whole earth has again the happiness of being "of one language and of one speech," I trust that that speech will be English.

OLIVER J. LODGE.

THE publication of a digest of the scientific papers which have appeared in the English language during even a limited period would entail serious difficulties. In the first place, the expense of printing would be considerable, and it would also be hardly possible to obtain the services of men competent to perform the task without paying them an adequate fee. In the second place, a satisfactory digest could not be published without the co-operation of the various scientific societies; and everybody who has had any experience as a member of the governing body of any club, society, or other institution is well aware of the difficulty of getting a dozen men, many of whom represent conflicting interests, to agree upon any definite scheme.

Still, I believe that the foundations of a scheme, which would be capable of development, might be constructed on somewhat the following lines:—

In 1889 the London Mathematical Society printed an index of all the papers published in the first twenty volumes of their Proceedings. The authors were arranged in alphabetical order, and their communications according to the dates of publication. This index will no doubt be brought up to date and reprinted, and I shall suggest (if I am then a member of the council) that an index of *subjects* shall also be printed, consisting of two parts viz. pure and applied mathematics, arranged in alphabetical order as regards *subjects*. Now if every scientific society which deals with pure and applied mathematics, or with experimental subjects which are capable of mathematical treatment, would co-operate with the London Mathematical Society in publishing an index of their own papers, arranged, printed, and paged in the same manner, it would be quite easy, by a rearrangement of the type, to print a joint index of all papers on these subjects which have been published, during the last twenty or thirty years, by the societies which co-operate. Each society would bear the expense of printing the original index of its own proceedings; and a proportionate part of the expense of printing and publishing the joint index, together with the profits derived from its sale, would be borne by and received by each society. It will be observed that the above scheme only contemplates a double index arranged according to authors and subjects, and not a *digest*; but every one who has had a little experience in hunting up papers, and also, I may add, law cases, will appreciate the value of such an index.

The editors of the Law Reports always insert under the title of each case a short paragraph in small print, giving an account of the points of law with which the case deals, from which the triennial digest is compiled; and if scientific societies would in future require authors to adopt the same course, the paragraph could be put into the index, and would be invaluable. The head-note need not amount to more than a few lines, and should describe the object of the investigation without entering into more detail than is absolutely necessary.

The various reports of the British Association on the progress of different branches of science contain much valuable information, and some of them might with advantage be printed in the index in a condensed form.

In conclusion, I would suggest that the governing bodies of the different societies should discuss this matter, and that a committee of delegates from those societies, which approve of united action, should be formed. The delegates ought, however, to be practical men well-versed in business, and able and willing to devote their time to the consideration of this question.

A. B. BASSET.

Birds' Methods of Steering.

THE flight of birds still presents several unsolved problems. How they steer, has never been fully explained. With the naked eye or, still better, with a field glass, many of them can be seen to use their tails, lowering the left or right side according to the direction in which they wish to go. This use of the tail as a rudder is much practised by pigeons, jackdaws, rooks, larks, swallows, housemartins, sandmartins, and I believe, by most of our common birds. Gulls let down a foot on one side or the other, and, no doubt, many other web-footed birds do the same. Still a rook or pigeon that has lost his tail manages to steer well, the chief result of the loss being that he cannot stop suddenly, nor float upon the air, but must take rapid strokes with his wings. What other method, then, has the bird of steering? One fact that bears upon this question can be easily observed. When a bird wishes to turn to the left he moves the centre of gravity of his body and flings himself on his left side, the right wing pointing upward and the left downward. How does he throw himself into this position? Most writers say that it is by striking harder with one wing than the other. In turning to the left the right wing would give a vigorous stroke, and so raise the right side of the body more than the left. At first sight it seems as if this explanation could not be the true one, since after a hard stroke the right wing should be lower than the left, which has only given a gentle one, and yet it is the right wing that is raised. But we must not be too hasty in drawing conclusions from this. When the down stroke takes place the wings do not descend far; the body rises so that the end of the wing appears to have described a much greater arc than it has done in reality. If, then, with the right wing a much harder stroke is given than with the left, the right side of the body will at once be raised, and the whole bird will be thrown upon its left side, while the movement of the wing itself may not be enough to be perceptible. If birds are watched as they fly, one wing seems always to be at the same angle to the body as the other, so that a straight line connecting the tips of the wings would pass through the two shoulder joints, or be parallel to a line passing through them. Instantaneous photographs of birds on the wing seem to me to bear this out. One wing may point up and the other down, but that is through the swaying of the whole body to one side or the other. In spite of this there may be an inequality of stroke that escapes detection, and without assuming this it seems on first thoughts difficult to account for the extraordinarily rapid turns made, for instance, by the swallow. But supposing that what appears to be the case is really so, viz., that equal force is put into both wings, there remains another possible explanation of this movement of the centre of gravity to the left or right in turning. If a bird wishes to steer leftwards, he may bend at the waist towards the left. So much has been said about the rigidity of the bird's backbone that its suppleness at a point just anterior to the ilium has been overlooked. I find that a swallow's vertebral column will bend at this point so as to form an angle of 150°; in the case of a kestrel it is 156°, of a tern 155°, of a sandmartin much the same as in the case of the swallow, in the case of a duck 165°; *i.e.* a duck can bend much less at the waist than the other birds mentioned, and you have only to watch ducks on the wing to see that they are very poor steerers. This is but meagre evidence, and, at present, I have not the means of collecting more. Still, as far as it goes, it seems to show that suppleness of waist goes along with the power of swerving rapidly, and, *a priori*, it seems extremely improbable that such a highly acrobatic feat should be performed without calling into play every power that is available. Direct observation can, I fear, afford little help, since the feathers obscure any slight bend in the back. But the habit that many birds have—it can be easily seen in the case of gulls—of turning their heads in the direction in which they wish to go, suggests that it may be by bending the vertebral column at a point where it would be more effective, that they make their turns, just as a skater changes edge and flies off on an opposite curve by swaying the weight of his shoulders across to one side or the other, a change of balance effected by a bend sideways at the waist. It is certain that birds do not depend entirely on movements of the head or neck, since gulls, for instance, may occasionally be seen to turn to the left while looking to the right and *vice versa*, a point which may be made out from instantaneous photographs. I cannot help thinking, then, that a bird avails itself of the suppleness of its waist to alter its balance when it wishes to turn. Whether this is the sole means, or whether at the same time the wings are worked

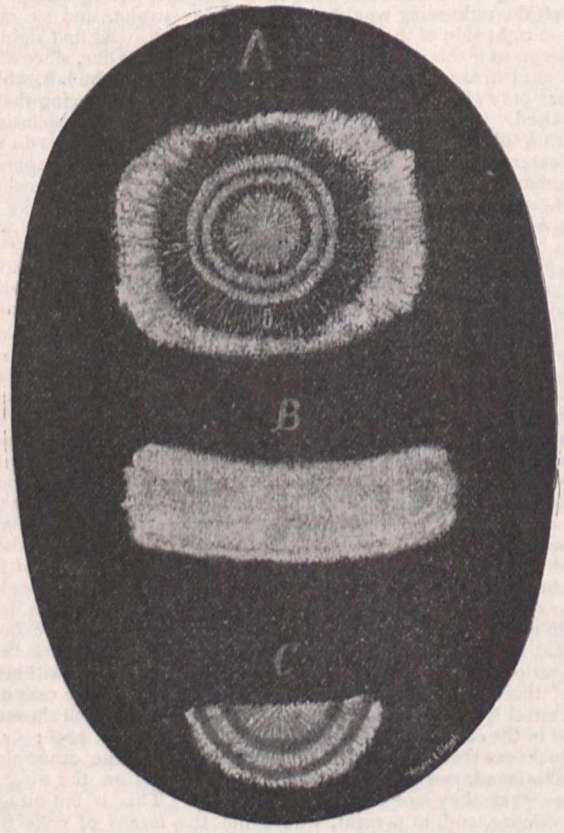
unequally so as to conduce to the same end is difficult to decide. I may add that I have found the required muscles at the waist considerably developed. F. W. HEADLEY.

Haileybury, Hertford, July 6.

Remarkable Hailstones.

ON Saturday afternoon, July 9, a very violent storm burst over Harrogate and its neighbourhood, accompanied by remarkably loud thunder and most brilliant and almost continuous lightning.

At first a little rain fell, but it was soon mixed with small hailstones about the size of peas of the usual form. These were quickly followed by hemispheres of the size and character indicated in Fig. C. After a few minutes they rapidly grew to the size of those shown in Figs. A and B, which are drawn very carefully to actual scale. Most were flattened oval discs, as shown in the two drawings, which exhibit top and side view of one hailstone. I went out myself and measured a good



number while they were falling by putting them on a sheet of paper and marking their maximum and minimum diameters. These large stones usually had an opaque spherulitic-like nucleus, followed by two, three, and even a trace of a fourth clear ice shell intervening with opaque ice. Then followed a broad band of clear ice with a few radiating air cavities, finally enclosed in a mass of white granular feathery ice. The number of alternating laminæ seemed to be irregular, and must have varied with that of the different vapour strata traversed by each nucleus. The origin of the type (Fig. A from Fig. C) is very obvious. The quantity that fell was enormous, so that a lawn badly kept was entirely white, with the exception of the longer blades of grass that projected. The damage done in the near neighbourhood must amount to some thousands of pounds, and very few are the houses in this town that escaped without windows being broken. I did not time the duration of the fall, but I think it was about an hour.

5, Princes Square, Harrogate. H. J. JOHNSTON-LAVIS.
July 12.

A Substitute for Ampère's Swimmer.

I HAVE long been dissatisfied with the rules commonly given in order to enable the relation between the direction of a current and that assumed by a magnet in its neighbourhood to be readily brought to mind. It is a small matter, but it causes a great deal of worry to many a student. The vagaries of Ampère's swimmer are "past the wit of man." Prof. Jameson's rule is not bad, but is not really easy to remember; the corkscrew is good, provided that you have a little time to think about it; but I have felt all along that it ought to be possible to devise something simpler than any of these. May I suggest that the following may perhaps be found useful?

If a pen be held in the right hand in the usual way, the penholder may be taken to represent the wire, and the direction of the flow of ink (that is, towards the point of the pen) the direction of the current; if, then, the thumb be stretched a little across the penholder it will represent the magnet, and the thumb-nail its marked or north-seeking pole. The hand may, of course, be twisted round into any position to represent any actual case. The same relation may be still more simply borne in mind by dispensing with the penholder, and merely laying the thumb across the forefinger of the right hand; either of these will then represent the current (flowing towards the finger, or the thumb-nail, as the case may be), the other the magnet.

Whether this is novel I do not know; it is so as far at I am concerned; but I think it is useful. ALFRED DANIELL.

Advocates' Library, Edinburgh, July 13.

The Jelly-fish of Lake Urumiah.

IN Mr. Curzon's recently-published work "Persia and the Persian Question" (vol. i. p. 533), he writes as follows:—"When the wind blows on Lake Urumiah, sheets of saline foam are seen scudding along the surface, and the salt is left upon the shore in a solid efflorescence, sometimes several inches thick. No fish or molluscs live in the waters, whose sole living contents are a species of *small jelly-fish*, which sustain the swans and wild fowl that are occasionally seen."

When Captain F. R. Maunsell read his interesting paper on Kurdistan to the Royal Geographical Society in June last, I asked him whether he could give me any further information respecting this so-called "jelly-fish," to which he was kind enough to reply as follows:—"In reply to your inquiries regarding the existence of a jelly-fish in Lake Urmia, I have been going through my notes, and find that I visited the lake on July 20 at its west shore, not far from the town of Urmia. I bathed in the lake and found the jelly-fish in great numbers along the shores where the water was shallow. It was only about half an inch in diameter, of a greenish-white, almost colourless, with a small black centre. There are said to be no fish or other living creatures in the water, and I did not see any. As you probably know, the lake is extremely salt, more so than the Dead Sea. The specific gravity is given as 1·155, with 21·4 per cent. of salt. The lake is 4,100 feet above the sea level, and has no outlet. There is a British Consul in Tabriz, which is not far from the east shore of the lake, who might obtain a specimen, and would be able to ensure its getting home safely better than any one else. The lake is very shallow compared with its great size, nowhere being more than from thirty to forty feet in depth."

The only instance of a "jelly-fish" or Medusa as yet known to inhabit an inland sea is that of the *Limnocnida tanganjicæ*, recently described by Mr. R. T. Günther (Ann. and Mag. N. H. ser. 6, xi. p. 274 (1893)). It would be therefore of great interest to obtain specimens of the "jelly-fish" of Lake Urumiah and ascertain what it really is.

3, Hanover-square, W., July 17. P. L. SCLATER.

Racial Dwarfs in the Pyrenees.

BEING on the Riviera when I received NATURE of January 26 with Mr. Haliburton's letter on the above subject, I proposed to act on his suggestion, and, on my way back to England, to explore the region indicated. To ensure, however, that the proposed exploration should not be a wild-goose chase, I first entered into communication with all the British consuls and French savants likely to have special knowledge of the subject, and more particularly with M. Cartailhac, director of *l'Anthropologie*, and who resides at Toulouse, "within little more than a

half-day's journey" from the valleys named by Mr. Haliburton. I was favoured with interesting replies from all those to whom I had written with the single exception, very curiously, of our consul at Barcelona, a letter from whom you published, and who appears to have been Mr. Haliburton's chief authority. As to the replies I received, I need only say that they so strongly negatived the assertion of there being "racial dwarfs," though admitting that there are "certains goitreux de petite taille," in the Pyrenean valleys, that I did not think it worth while to make the proposed journey. And as Mr. Haliburton repeats, in the current *Asiatic Quarterly*, the assertions made in NATURE, I feel bound to state these facts, though I may say that I quite agree with him as to the probability of a former wide distribution of dwarf races, and should have found Pyrenean dwarfs, had they been discoverable, in most interesting relations to the Ligurian giants, whose caves I had been exploring at Baoussé Roussé—the "Red Rocks" of Grimaldi.

Athenæum Club, July 10. J. S. STUART-GLENNIE.

THE NOTTINGHAM MEETING OF THE BRITISH ASSOCIATION.

THE forthcoming meeting of the British Association in Nottingham recalls the year 1866, when the present Mr. Justice Grove presided over the meeting in the town, and delivered his epoch-making address. Although this was the only meeting held in Nottingham, national conferences and associations of all kinds are constantly gathering in this very convenient, healthy, and picturesque centre; the inhabitants are therefore accustomed to the entertainment of guests. The public buildings will also be found to offer special facilities for the usual work of the British Association.

The University College, a large building almost central in position, has naturally been allotted to the meeting of the various sections. The lecture-theatres and class-rooms of the College provide accommodation for all the sections with the exception of two, and these will gather in commodious rooms in the immediate vicinity.

The various laboratories of the College are to be devoted to the exhibition of scientific apparatus and diagrams, some of which will be used during the meeting for the illustration of papers in the sections; and since these laboratories are very convenient for the purpose and are in direct communication with the sectional meeting-rooms, it is hoped that authors of papers will be induced to bestow special attention to the illustration of their papers, as the illustrative matter will be permanently on view throughout the meeting.

The Corporation of Nottingham not only grants the use of the University College, but also gives permission for the Castle Museum to be used for the conversaziones, and throws open the Exchange as a luncheon hall, with smoking-room and ladies' room as adjuncts. The large luncheon room thus provided will be supplemented by another large and convenient room in the University College.

The large hall at the Mechanics' Institution will be fitted as the reception-room with all the usual conveniences, the Albert Hall being reserved for the popular lectures, the president's address, and for a special concert to be given on Saturday evening by the Sacred Harmonic Society of the town.

It will be found on reference to a local map that not only are these various buildings easy to find, but that they lie most conveniently within range of one another, the extreme distance not exceeding a walk of five minutes.

The inhabitants of Nottingham are quite alive to the duties of hospitality, and not only will the officials and working members of the Association receive entertainment in private houses, but the clubs of the town are also throwing open their doors with one consent. A list of hotel and lodging accommodation is nearly ready for issue.

The local excursions include visits to the Dukeries, Charnwood Forest, Lincoln, Belvoir Castle, and Derbyshire; and, in connection with these visits, hospitality has been offered by the Duke of Portland, the Duke of Newcastle, the Duke of Rutland, and the Bishop of Southwell. Many other offers of hospitality are expected. Important works in the town and neighbourhood will also be open for inspection.

The local programme and excursion handbooks are in an advanced stage of preparation. These will serve as guides to the public buildings used for the meetings and indicate the hotels and lodgings, and the routes followed in the various excursions; they will also give information concerning the natural history of the district.

The work of the local committee would be greatly facilitated if all those who intend to be present or to take part in the meeting would communicate with the local secretaries, Guildhall, Nottingham, as soon as possible.

Without unduly anticipating the information which will be found in the local programme and publications, enough has been said to indicate that the local committee are actively preparing for the reception and entertainment of the members of the Association; and it is proposed next week to give some statement of the more serious work which will engage the attention of the general meeting and of the sections.

FRANK CLOWES.

THE GREAT DROUGHT OF 1893.

THE draught of 1893 will unquestionably take its place among the recorded events of history, if regard be had to its intensity, the length of time during which it has lasted, and the wide extent of the earth's surface it has overspread. Treating the British Islands as a whole, the drought may be considered as embracing by much the greater part of the country for the fifteen weeks beginning with March 5. But while copious rains have fallen during the past few weeks in many places, it may be regarded as continued to near the present time in many of the more important agricultural districts in the south.

The drought was most severely felt in the southern division of England, and least in the north of Scotland. Over Scotland, England, and Ireland it increased in intensity, with pretty uniform regularity, from north to south. Thus the deficiency in percentages from the average rainfall of that portion of the year was 30 at Lairg and 59 in Berwickshire; 59 at Penrith, and 90 at Dungeness and Falmouth, and 38 at Londonderry and 67 at Waterford. The least deficiency at any of the stations of the *Weekly Weather Report* was 1 at Glencarron, in Ross-shire, and the greatest at Dungeness and Falmouth, as stated above. At Glencarron the amount of the rainfall was 16·91 inches, whereas it was only 0·60 inch at Dungeness, 0·77 inch in London, 0·92 inch in Scilly, and 0·94 inch at Falmouth. At places south of a line drawn from Cambridge to Scilly less than a fourth part of the average rainfall of these fifteen weeks was collected, and consequently over this large district the effects of the drought have been most disastrous to agriculture and horticulture, the hay crop, for example, being in many places a complete failure. It was altogether a unique experience, in travelling in June from London to Scotland, to mark the great and steady improvement in the condition of the crops in the northward journey.

During the period the type of weather prevailing was eminently anticyclonic, with the appearance, ever and anon, in localities more or less restricted, of small satellite cyclones with their attendant thunderstorms and rains. Hence the remarkably sporadic character of much of the rainfall, of which the most remarkable in-

stance was a rainfall of 1·19 inch at Parsonstown on June 10 and no rain whatever at any other of the telegraph stations of the Meteorological Office in this country. Heavy local rains of this type, with downpours of an inch or upwards, were recorded on May 17, 18, 20, and 21, and June 10. It is also to be noted that many thunderstorms occurred during the period unaccompanied with rain, just as happened generally in the east of Scotland in June 1887, on the day of the Queen's Jubilee; and frequently large drops of rain fell, quite insufficient even to wet the ground, and scattered over narrow paths of inconsiderable length. Very heavy rains occurred over the eastern districts of Scotland, practically terminating the drought there, on June 22 and 23, when on these two days 4·20 inches fell at the North Esk Reservoir on the Pentland Hills, 3·32 inches at Roslin, 2·21 inches at Aberdeen, 2·06 inches at Logie Coldstone, near Ballater, and nearly two inches at many places, whilst generally in the west little and at many places no rain fell at all.

Temperature was phenomenally and almost continuously high in March, April, May, and June, specially as regards the first three of these months. Thus, for London the mean of the three months was 4°·3 above the mean of the previous 130 years; and in Edinburgh 3°·3. The only springs since 1763 with a mean temperature exceeding that of 1893 were for London, 1811 and 1794, which were respectively 5°·2 and 4°·3 above the average; and for Edinburgh, 1779 and 1781, which exceeded the mean by 4°·0 and 3°·8. It is highly interesting to note that large as these figures are, the Ben Nevis figures far exceed them, the mean temperature at this high-level observatory for March, April, and May last being 6°·6 above the mean of these months, a result due to the prevailing anticyclones, which so frequently are attended there with abnormally high temperatures.

The drought has also extended over nearly the whole of Europe, large portions of Canada, the United States, and other parts of the globe. In the north of Italy no living person recollects to have seen the Italian Lakes so low, and the southern Alps so greatly denuded of their snow covering. It is estimated that over the wheat-growing countries of the world this valuable crop will be to no inconsiderable extent under the average. On the other hand, in other parts of the world the rainfall has been exceptionally heavy, and followed with widespread disastrous floods, as in the cotton districts of the United States, and in Queensland.

In London, the total amount of rain that fell during the 110 days from March 4 to June 22 was 0·77 inch. Mr. Symons, our best authority on the question of droughts, enumerates eight droughts which have been recorded during the present century. Of these the longest continued was 105 days, from March 11 to June 23, 1844; and thus the drought of the present year is the greatest in the British Islands authenticated by meteorological records.

NICOLAS IVANOVICH LOBATCHEFSKY.

NICOLAS IVANOVICH LOBATCHEFSKY, the founder of Non-Euclidean Geometry, was born on November 2, 1793.

A student, and subsequently professor at Kasan, the Physico-Mathematical Society of that interesting University have determined to celebrate the centenary of his birth by founding an International prize for Mathematical, and in particular, for Geometrical work bearing upon the late-born but remarkable branch of mathematical science and philosophy which owes its existence to Lobatchefsy's genius and has earned for him the title of the Copernicus of Geometry.

A committee including the names of Tchebyche, Poincaré, Hermite, Darboux, Klein, Sophus Lie, Lindemann, Cayley, Beltrami, Newcomb, Mittag-Leffler, and over a hundred other notabilities of the mathematical world in both hemispheres, has been appointed to assist in carrying out the plan.

At this time of day it would be superfluous to dilate on the pre-eminent claims to honourable recognition of one who has played a principal part in reconstituting the basis of geometrical thought and realised his ideas in a series of memoirs with a thoroughness and precision which Gauss in 1846 characterised as the work of "a true geometer."

Any English mathematician (and it is to be hoped there will be many) desirous of co-operating in erecting this monument (if it may be so called) to the memory of a great scientific reformer, may do so by forwarding a subscription addressed to Prof. Vassilief, President of the Physico-Mathematical Society, University of Kasan.

NOTES.

WE greatly regret to record the death of Dr. John Rae, F.R.S., at the age of eighty-one. It was he who, in 1854, collected relics of the ill-fated Franklin expedition in the *Erebus* and *Terror*.

AMONG the Civil List pensions granted during the year ending June 20, 1893, we note one of £75 to Mrs. Dittmar, in consideration of the services to chemical science rendered by her late husband, Prof. William Dittmar, F.R.S., and one of £50 to Mrs. T. Wolstenholme, in consideration of the merits of her husband, the late Rev. Joseph Wolstenholme, as a mathematician, and of her straitened circumstances.

FOR the convenience of those who wish to be present at the Rothamsted celebration on Saturday next, a special train will leave St. Pancras for Harpenden at 2.2 p.m., returning at 5 p.m. In connection with the celebrations at Rothamsted, it is interesting to recall the circumstance that in the early part of the present century the signal services rendered by Francis, Duke of Bedford, to the theory and practice of agriculture were recognised by the erection, in Russell Square, of a collossal statue to his memory. The scheme, in the first instance, was initiated by Sir Joseph Banks, then president of the Royal Society, the first meeting on the subject being held at his house in Soho Square. Subscriptions were solicited from the various agricultural societies existing at the time, and from private individuals, and these flowed in with many expressions of approval of the object in view. The statue and its pedestal, the latter emblematical of the art of husbandry, were designed by Richard Westmacott, who received the sum of £6000 for the work, each subscriber receiving an engraving of the design. An inscription records that the statue to the Duke was erected by his fellow labourers in the field of agricultural improvement in gratitude for his unwearied endeavours to improve the theory and practice of agriculture.

THE French Association for the Advancement of Science will hold its annual meeting from August 3 to August 13, at Besancon, under the presidency of Dr. Bouchard. The subjects for discussion in different sections are the mechanical traction of tramways, the local records from which a forecast of the weather at a given place can be made, the *rôle* of humus, works of commerce, and the administrative measures necessary to prevent the use of unfit articles of food.

THE death is announced of Mr. Walter White, who for upwards of forty years served the Royal Society, first in the capacity of clerk and afterwards of assistant secretary and Librarian. Mr. White retired from the latter post in 1885, and

has from that time received a pension from the society. His bent was literary rather than scientific, and he was the author of several books of holiday travel written in a pleasant style and in that correct English upon which he always prided himself. Mr. White died on Friday last, in the eighty-third year of his age.

THE annual congress of the British Institute of Public Health will be held at Edinburgh from July 27 to August 1, under the presidency of Dr. Henry D. Littlejohn and the auspices of the Lord Provost and Corporation of Edinburgh.

THE Société Belge de Géologie et d'Hydrologie has arranged an excursion of some interest for August 4 to 9, under the direction of M. E. Dupont, the special object being to study the hydrology of the district around Dinant, Namur, Rochefort, Madave, &c. The springs and surface-streams will be examined, and also the famous Grotte de Han. Attention will also be paid to other physical features of the districts, including the formation of valley-terraces and the origin of the loam on the plateaux.

THE annual exhibition of the Photographic Society of Great Britain will be held at the Gallery of the Royal Society of Painters in Water-Colours, Pall Mall, from September 25 to November 15. It will be opened by a reception held by the President, Capt. Abney. The last day for receiving pictures is September 11.

THE Aspatria Agricultural College, which has been rebuilt and greatly enlarged, was opened on July 21 by the Mayor of Carlisle, before a large and representative gathering.

A STATUE of Claude Chappe, the inventor of the system of semaphore signalling, has recently been erected on the Boulevard Saint-Germain, Paris.

THE Société Industrielle de Mulhouse has issued its programme of prizes to be awarded in 1894. Prizes will be given for works on the constitution of various colouring matters, mordants, dyes, the fixing of colours, areometry, drugs, bleaching, actinometry, and other subjects. In mechanical arts the prize-subjects relate to building construction, steam engines, motors, spinning and weaving, electric motors, and the comparative advantages of gas and electricity for lighting purposes. There are also prizes for subjects of natural history and agriculture, commerce, statistical and historical geography, and the fine arts. The prizes are open to persons of all nationalities. Competitors should send in their memoirs, plans, and specimens, marked with a pseudonym or motto before February 15, 1894, to the President of the Society. The same pseudonym or motto, with the full name of the sender, must be forwarded under separate cover at the same time. A detailed programme of subjects for which prizes will be awarded, can be obtainec by application to the Secretary of the Society, Mulhouse, Alsace.

WHEN it was resolved last January "That it is desirable that the eminent services of the late Sir Richard Owen in the advancement of the knowledge of the sciences of anatomy, zoology, and palæontology should be commemorated by some suitable memorial," it was confidently expected that there would be a generous response to the appeal for funds. A large number of circulars were sent out, yet the list published in June contains the names of less than 300 contributors. The donations then amounted to £935, and the amount promised has even now only reached £1000, whereas the committee hoped to obtain at least twice that sum. For those who have come orward there is nothing but praise; the cause of complaint lies in the paucity of subscribers. Only 300 admirers of Owen can be found desirous of giving concrete expression to their feelings of regard. The fact is humiliating, and, for the sake of British science, we trust it will soon be altered. Of Sir Richard Owen it can truly be said, that among students of science "Many shall commend his understanding; and as long as the world endureth, it shall not be blotted out; his memorial shall not depart away, and his name shall live from generation to generation." But Owen's greatness should not only be appreciated by men of science, it should be made known to the world by means of a monument. As a mark of respect to their master and an act of duty, all naturalists should add a stone to his cairn.

ONE of the conclusions arrived at in 1888 by the Commission appointed to investigate the action of light on water colours, was that "every pigment is permanent when exposed to light '*in vacuo*,' and this indicates the direction in which experiments should be made for the preservation of water-colour drawings." Actuated by this expression of opinion, Mr. W. S. Simpson has devised a simple and effective means whereby works of art can be isolated from the deteriorating effects of air and moisture. The picture which it is desired to preserve is placed face downwards in a shallow rectangular tray having a clear glass bottom, and is then covered at the back. The chamber thus formed is afterwards exhausted by means of a Spregnel pump, and hermetically sealed. Assuming that no leakage occurs, and that light has no intrinsic action upon pigment, the picture will be preserved in all its pristine beauty until the crack of doom. To test for leakage, a small manometer, constructed on the principle of the aneroid barometer, can be fixed to each isolated picture. Mr. Simpson's idea is a good one, and it possesses the inestimable advantage of being applicable to any picture, for all that is required is to take the picture from its frame and fit it into an air-tight chamber of the same size before replacing it. Should the vacuum not maintain its integrity, the manometer will indicate its imperfections, and the chamber can easily be exhausted again. It appears, therefore, that the method has great possibilities before it.

WITH regard to the statement made by Mr. E. Douglas Archibald in our issue of May 25, that the highest rainfall in twenty-four hours was 40·8 inches, registered at Chirapunji, in the Khasi hills, a correspondent writes to the *Ceylon Observer* as follows:—"If the *Indian Planters' Gazette* of 28 Jan., 1893, is correct, the following paragraph establishes a still higher record. On page 59 one reads: 'Our Dera Doon correspondent writes on January 24, 1893: last night we had 48 inches of rain, and all the hills are covered with snow. It is still raining.'" For this to have any scientific value, however, it must be known who were the observers, and by what means the rainfall was gauged.

THE duration and form of temperature waves as they occur at Trieste has been studied by Herr Ed. Mazelle, and described in a recent communication to the Vienna Academy. Daily records during the period from 1871 to 1890 show a mean wave length of 4·23 days. The longest waves occurred in winter and summer, the shortest in spring and autumn at Trieste, in marked contrast to Central Europe, where the reverse occurs. The mean duration of increase of temperature was always longer than that of fall of temperature, in the proportion of 2·39 to 1·84. For dull days both the periodic and the aperiodic diurnal variation were of less extent, but both the maxima and minima of temperature occurred earlier in the day. The variability of mean daily temperatures was different for different parts of the year, showing maxima in January and July, and minima in September and April. The occurrence of the first day of frost was found to vary between wider limits than that of the last frost.

THE German Meteorological Office has issued a volume containing the results of rainfall observations for the year 1891,

together with a circular stating that the number of meteorological stations has so greatly increased as to make it advisable to publish five volumes yearly instead of one, two of which will be devoted to the magnetical and meteorological observations made at the Observatory at Potsdam. The number of rain stations has increased from 35 to 1425 since the establishment of the office in the year 1847. In addition to the usual monthly and yearly summaries, the greatest amounts which have fallen in short intervals are given for a large number of stations. These values show clearly how the intensity of the fall decreases with the duration, and that erroneous ideas may be obtained by estimating the hourly fall from that of a shorter period, as is sometimes done. The greatest fall during five minutes in the year 1891 amounted to ·15 inch per minute, during thirty minutes to ·08 inch per minute, and during one hour to ·04 inch per minute. The greatest fall registered in any one day was 4·3 inches on the May 26; a fall of 4·2 inches was also recorded on July 21.

SOME idea may be formed of the rate of increase of the known species of fungi from the fact that, in a recent issue of the Proceedings of the Philadelphia Academy of Sciences, MM. Ellis and Everhart describe no less than 149 new species from North America. Of these 53 belong to the Pyrenomycetes, 24 to the Discomycetes, 11 to the Uredineæ, 2 to the Ustilagineæ, 46 to the Sphæropsideæ, 13 to the Hyphomycetes.

A FLORA of Donegal, by Mr. H. Chichester Hart, is about to be published. Until recent years the north-west of Ireland had been greatly neglected by botanists, and the publication is likely, therefore, to be of much interest.

THE first part of MM. Rouy and Foucaud's "Flore de France" is announced to appear in August. The geographical area of the work includes, in addition to France proper, also Alsace, Lorraine, and Corsica; and there will be comprised a bibliography and a list of botanists who have contributed to our knowledge of the flora of France. The first volume of M. Bounier's "Florede la France," published under the auspices of the Ministry of Public Instruction, is expected to appear in the spring of 1894.

TWO recent numbers of the *Botanisches Centralblatt* (vol. liv. nos. 12 and 13) are largely occupied by a review by Dr. Otto Kuntze of the discussion on botanical nomenclature since the publication of his "Revisio generum plantarum" in 1891.

MR. MARK STIRRUP has just published further information as to the occurrence of boulders in the coal measures of Lancashire (Trans. Manchester Geol. Soc., vol. xxii. p. 321). Most of the boulders hitherto recorded are of quartzite; some of those here described are of crystalline rock. Petrographical notes are given by Prof. Bonney. Mr. Stirrup also prints a letter from Prof. E. Orton relating to the occurrence of boulders of vein-quartz—not quartzite—in the coal measures of Ohio (see also *Amer. Journ. Sci.*, July 1892).

BOULDERS have been recently described from the Kulm beds of the Frankenwald, by E. Kalkowsky (*Zeitsch. Deutsch. geol. Gesell.* 1893, p. 69), who thinks that they indicate glacial action. This explanation is not satisfactory for the English boulders in coal measures, the origin of which is still unknown.

PROF. FRANK D. ADAMS has published an interesting description of the Norian Rock of Canada ("Ueber das Norian oder Ober-Laurentian von Canada" extracted from *N. Jahrb.*, Beilagebd. viii., 1893, pp. 419–498). This forms a thesis for the doctor's degree at the University of Heidelberg. The Norian rocks consist mainly of "anorthosite," in which plagioclase is the chief constituent, ferro-magnesian silicates being scarce or absent. These rocks are intrusive in the Grenville series—the upper division of the Lower Laurentian of Logan, who regarded the Norian series as Upper Laurentian. Prof. Adams shows that the anorthosites occur near the eastern edge of the great Archæan platform of Canada. He compares this with the distribution of modern volcanoes along the edges of the Continents. Some of the anorthosite masses are of great extent; that of the Saguenay district covers an area of nearly 6000 sq. miles, that of Morin 1000 sq. miles. These results may be compared with the conclusions already published by Prof. A. C. Lawson, that the Laurentian gneisses of the Rainy Lake region are intrusive in the so-called "Huronian" of that area, rocks which were previously considered to be later than the Laurentian. Prof. Adams's paper contains a map of the Archæan area of Canada and a full bibliography.

EXPERIMENTS on the value of ammonia vapour as a disinfectant have been recently made by Rigler (*Centralblatt für Bakteriologie*, vol. xiii. No. 20). The organisms employed were Koch's cholera bacillus, the typhoid bacillus, Loeffler's diphtheria bacillus, and the spores and bacilli of anthrax. Threads soaked in broth-cultures of these various organisms were freely exposed in a room filled with ammonia vapour, whilst other threads were wrapped up in dry and damp cloths respectively before being submitted to the vapour, and in every case control threads were simultaneously exposed to air. It was found that cholera bacilli were killed after two hours' exposure in the ammonia room, whether free or enclosed in dry cloths, whilst twice that time elapsed before they succumbed in moist surroundings. In ordinary air they were destroyed in three hours, but they were alive after two days when kept in *moist* cloths. Two hours' exposure in the ammonia vapour, whether freely exposed or in dry wrappers, sufficed to destroy the typhoid bacilli, but in moist surroundings six hours was necessary, whilst twenty-four hours' contact with ordinary air produced no effect upon them. Anthrax bacilli succumbed in three hours in the ammonia room, but their existence was prolonged for five hours when wrapped in dry cloths, whilst whether in dry or moist surroundings a day's exposure in ordinary air left them untouched. The spores, however, were only destroyed after being eight hours in the ammonia vapour, and in ordinary air were unaffected. Diphtheria bacilli, whilst surviving twenty-four hours' contact with ordinary air, were annihilated in four hours by the ammonia vapour, the nature of their environment making no difference in their powers of resistance. In consequence of its efficacy, cheapness, and harmless character as regards furniture and clothing, Rigler recommends ammonia vapour as an important means of disinfection.

THE metric measures are in general use in Russia in scientific literature. They have also been adopted by the Mining Administration in all its publications, while the railway and water communications engineers are using the decimal divisions of the Russian *sagène* (7 English feet). Prof. Petrushevskiy, who has advocated since 1868 the adoption of metrical measures, now gives in the Journal of the Russian Chemical and Physical Society his scheme of metric measures, as near as possible to the present Russian measures, so as to make them easily acceptable to the population. It must be said that the general use of the *schoty* (reckoners, made of wires with ten beads on each wire, and used by all peasants, as well as by primary schools for the teaching of arithmetic) and the decimal division of money would greatly facilitate the acceptance of the metric system in Russia. The change is also facilitated by the fact that the Russian *sagène* is very nearly equal to 2 metres, the *versta* is nearly equal to the kilometre, and the *desiatina* differs but little from the hectare. The system proposed by Prof. Petrushevskiy is both plain and at

once intelligible. It is that the *new sagène* shall be equal to the double metre (0·9374 of the present measure) and that a *half sagène* equal to one metre shall be divided into 20 *vershoks* (5 cm. are equal to 1·1248 of the present *vershok*). Also that the new *versta* shall be equal to the kilometre (0·9374 of the present *versta*), the *small desiatina* to the hectare and to 0·9153 of the present *desiatina;* the *big cube* to 10 cubic metres and to 1·0296 cubic *sagènes;* the *small vedro* to 10 litres and to nearly four-fifths (0·0131) of the present *vedro;* the *big measure* (1000 litres) to nearly five (4·795) *tehetveriks;* and finally the *big pound* (500 grammes) equal to 1·221 Russian pounds. It will be seen that the whole system is consistent with the spirit of the metric system, which fully admits of measures obtained from the multiplication of the metric ones by 2, 5, or 10, or from their divisions by the same members.

SIGNOR RICCARDO ARNÒ has communicated to the Reale Accademia delle Scienze di Torino his results obtained during an investigation of the diathermanous power of ebonite for heat waves of various lengths. He employed six different sources of light, whose radiant heat was sent through plates of ebonite of thicknesses varying from 0·12 to 0·52 mm. The thinnest of these absorbed 25 per cent of the heat radiated from an incandescent lamp, whose luminous heat rays were cut off by a thick plate of glass. When the source of light was very bright, this film was found to transmit a small portion of the visible red rays. Sixty-nine per cent. of the dark rays from the smoked surface of a Leslie cube containing boiling water were absorbed by the thinnest film, and 88 per cent. by the two others, thus showing that ebonite is less transparent for dark heat rays of low refrangibility than for those more approaching the visible spectrum. The greatest transparency was shown for the dark heat rays on the border of the luminous spectrum. The successive substitution of a hot iron plate, a glowing platinum wire, a Locatelli lamp, and an incandescent lamp for the Leslie cube brought about a steady increase of transmitting power in all the specimens of ebonite.

PROFS. BARTOLI AND STRACCIATI have brought their eight years' work on the specific heat of water to a close by reducing the values obtained with the nitrogen thermometer as a standard to the scale of the hydrogen thermometer. The corrected formula for the quantity of heat necessary to raise the temperature of 1 gramme of water from 0° to t° C., where t is less than + 31, as given in the *Rendiconti* of the Reale Istituto Lombardo, is

$$1{\cdot}006880t - 278 \times 10^{-6}t^2 - 205 \times 10^{-8}t^3 + 25375 \times 10^{-11}t^4 - 26 \times 10^{-10}t^5.$$

This formula, obtained by eight different methods and several thousand determinations, appears capable of serving as a reliable basis for calorimetrical science.

IN a further note contributed to the Academy of Lincei, Augusto Righi continues the description of experiments he has conducted with electrical oscillations of very small wave-length (see NATURE, June 22, 1893). The oscillator employed consists of two small metal spheres surrounded with oil and held by two rods of ebonite. These two spheres are placed between the discharging rods of a large Holtz electrical machine. With spheres 4 cm. in diameter the wave-length of the radiation obtained was 20 cm., while with spheres of 1·3 cm. diameter the wave-length was about 7 cm. The resonator employed was of a novel form and was made by taking a rectangular piece of ordinary silvered glass of such a size that its breadth was equal to the length of the resonator required. The varnish was then dissolved off the back of the silver, and a line drawn through the silver by means of a diamond, so as to divide the strip of silver into two equal parts, and form a spark gap. By this means a spark gap was obtained, having a breadth of between one and two thousandths of a millimetre. For radiation having a wave-length of 7·5 cm. the resonator was composed of a strip of silver 3·9 cm. long and 0·2 cm. broad. Although with these small wave-lengths the sparks cease to be visible when the distance between the oscillator and resonator is a metre, by placing a parabolic metallic reflector behind the resonator the sparks were visible at a distance of six metres from the oscillator. Using the above form of apparatus the author has repeated the experiments of Lodge and Howard and others on the reflection and refraction of electrical waves, he has also succeeded in producing interference between the rays reflected from two mirrors inclined at a slight angle (Fresnel's experiment). An interesting set of measurements of the transparency of various dielectrics gave (amongst others) the following results:—Ebonite, paraffin, and rock salt are perfectly transparent. A plate of mica 1·7 mm. thick absorbs 10% of the radiation, while a plate of ordinary glass 8 mm. thick absorbs 37%, and a piece of quartz cut normally to the axis 8 mm. thick absorbs 40%.

WE have received the first part of "The Book of the Fair," by Mr. Hubert Howe Bancroft. It is grandiloquently described on the title-page as "An Historical and Descriptive Presentation of the World's Science, Art, and Industry, as viewed through the Columbian Exposition at Chicago in 1893. Designed to set forth the Display made by the Congress of Nations, of Human Achievement in Material Form, so as the more effectually to illustrate the Progress of Mankind in all the Departments of Civilised Life." The part of the book before us deals with great fairs of the past, and the history of Chicago, the object apparently being to make the story as long as possible. Both the text and illustrations are excellent.

A COLLECTION of meteorological tables, compiled by Dr. Arnold Guyot, was issued by the Smithsonian Institution in 1852. The fourth edition was published in 1884, and the work had then grown to a bulky tome of more than 700 pages. Upon a demand for a fifth edition, Prof. S. P. Langley decided to publish the tables in three parts: Meteorological Tables, Geographical Tables, and Physical Tables, each independent of the other, but the three forming a homogeneous series. The volume of meteorological tables is before us, and it is of far more handy dimensions than formerly. Everything appertaining to meteorological work appears to be contained therein, and the fact that the work comes from the Smithsonian Institution vouches for its excellence. Our attention has been directed to a slip on p. 248. In the list of meteorological stations in the British Isles given on that page we find printed "Richmond (*Greenwich Observatory*)," lat. 51° 29′ N., long. 0° 0′. The first word should be omitted in future editions, for Greenwich, and not Richmond, is obviously referred to.

NINETEEN charts of the "Isle of Wight and Solent Tides," from Portland Bill to the Owers, have been prepared by Mr. T. B. C. West and Mr. F. Howard Collins, and are published by Mr. J. D. Potter, Poultry, E.C. They show by means of arrows the direction of tidal streams at all hours, and, at some places, for half hours of the tides. The rates given are for spring tides, but those for neap and average tides can easily be estimated. The charts are excellently engraved from an Admiralty chart, and the arrows are placed in accordance with the information contained in the "Channel Pilot." They are issued in an extremely compact form, and to the yachtsman of the Isle of Wight district must prove invaluable.

"EVOLUTION AND RELIGION," by Mr. A. J. Dadson, has been published by Messrs. Swan, Sonnenschein and Co. The first three chapters of the book are concerned with the doctrine of evolution, and the remainder deal with theological matters, while the whole has been written with the laudable object of bringing about a reconciliation between religion and science. May the truth prevail.

MESSRS. WEST, NEWMAN, & Co., have just published a book by Mr. S. T. Dunn on the flora of South-West Surrey, including Dorking, Godalming, Farnham, and Haslemere. The last flora including this district was Brewer's, dated 1863. Another county flora is in preparation by Mr. W. H. Beeby. It need scarcely be said that Mr. Dunn's little book is not intended to take the place of these more complete floras, but it will serve as a portable field guide to visitors.

THE sodium salt of the as yet little-known perchromic acid has been isolated by Dr. C. Häussermann in the state of well-defined crystals, and is described in a communication to the current number of the *Journal für Praktische Chemie*. The possibility of the existence of an acid-forming oxide of chromium higher than the trioxide CrO_3 has formed a subject of discussion for many years. It was long considered that the deep blue coloration produced upon adding hydrogen peroxide to a solution of chromic acid was due to the formation of the hydrate of a peroxide of chromium. Both the first observer of this interesting reaction, Barreswill, and Ascher in a subsequent memoir, considered the peroxide to possess the composition Cr_2O_7, corresponding to the heptoxide of manganese, Mn_2O_7 present in the permanganates. Fairley has since attributed to the blue compound the composition $CrO_6.3H_2O$. Latterly, however, Moissan has adduced evidence in support of the view that the substance is nothing more than a molecular compound of chromic anhydride with hydrogen peroxide, $CrO_3.H_2O_2$. The work of Häussermann is therefore particularly interesting as showing that, whatever may be the truth concerning the blue compound above referred to, a higher acid of chromium is capable of existence. Moreover, it is not without some significance that the formula of the anhydride derived by Häussermann from the analyses of his sodium salt coincides with that, CrO_6, attributed by Fairley to the oxide present in the blue compound. Häussermann finds that when sodium peroxide is added in small quantities at a time to chromic hydrate suspended in a small quantity of water and maintained at a low temperature by means of an ice bath, a somewhat violent reaction occurs, rendering constant agitation necessary; the chromic hydrate dissolves, a brownish-yellow solution being produced. When this liquid is allowed to stand undisturbed for a time in a cold room, brilliant brownish red, transparent, monoclinic crystals separate. These crystals are found upon analysis to possess the composition $Na_6Cr_2O_{15}.28H_2O$. They rapidly effloresce upon exposure to the air, falling to a brown powder. They lose the whole of their water of crystallisation when placed in a desiccator over oil of vitriol, or when heated to 100°. At a temperature of 170° they explode with some violence, leaving behind a quantity of sodium chromate mixed with sodium hydrate. The anhydrous salt is tolerably stable and is only very slowly attacked by cold water. Hot water, however, immediately decomposes it with formation of a solution of sodium chromate and sodium hydrate and liberation of three molecular equivalents of oxygen gas.

$$Na_6Cr_2O_{15} + H_2O = 2Na_2CrO_4 + 2NaOH + 3O_2.$$

Analyses of the anhydrous salt agree with the formula $Na_6Cr_2O_{15}$, indicating an anhydride of the composition Cr_2O_{12} or CrO_6. It is most interesting that, upon the addition of dilute sulphuric acid to the salt, the deep blue coloration above alluded to is at once produced, as if it were due to the formation of the free acid, the hydrate of CrO_6. In a few minutes oxygen commences to be evolved, and chromic sulphate is formed in the solution. Alkalies are practically without action upon the salt, which would thus appear to be stable in alkaline solution.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include a colony of a tall (1½ ins.) variety of the Hydroid *Coryne vermicularis*, Hincks, the Polyzoan *Pedicellina echinata*, and the Tunicata *Phallusia mammillata* and *Ascidia depressa*. An incursion of the Cladocera *Podon* and *Evadne* has characterised the floating fauna; and with these have been taken Cirrhipede *Nauplii*, *Cyphonautes* larvæ, and countless numbers of minute *Obelia* medusæ. The following animals are now breeding:—The Cephalopod *Sepiola atlantica*, the Malacostraca *Chelura terebrans*, *Limnoria lignorum* and *Eupagurus Prideauxii*, and the Echinoderm *Echinus acutus*.

THE additions to the Zoological Society's Gardens during the past week include two Great Eagle Owls (*Bubo maximus*), European, presented by Lord Hill; two Barbary Turtle Doves (*Turtur risorius* var.) from the Pescadore Islands, China, presented by Mr. Theodore A. W. Hance, C.M.Z.S.; three Giant Toads (*Bufo marinus*) from Brazil, presented by Mr. Adamson; a yellow-cheeked Lemur (*Lemur xanthomystax*) from Madagascar, a Banded Ichneumon (*Herpestes fasciatus*) from West Africa, deposited; a Black Ape (*Cynopithecus niger*) from the Celebes; two Black-headed Mynahs (*Temenuchus pagodarum*), two Manyar Weaver Birds (*Ploceus manyar*), two Red-headed Buntings (*Emberiza luteola*) from India, purchased; two Dominican Gulls (*Larus dominicus*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE DISCOVERY OF THE NEW COMET.—The new comet seems to have been noted by a number of observers before they had seen its discovery announced. Mr. Edgar Richards writes to us as follows in a letter dated July 13:—

"On Sunday last, the 9th inst., at 9.30 p.m., the members of the Astronomy Club, composed of several of the lady guests of the Cliff House, Minnewaska, N.Y., U.S.A., saw in the north-western heavens a most brilliant comet with well-defined nucleus and bright tail. The comet was in the constellation Lynx, and its tail extended towards the North Star. Its motion was very rapid in a south-westerly direction, and the tail was momentarily increasing in length as long as the comet was visible. The Club suffers from the disadvantage of not possessing a good telescope, so observations have to be made unassisted. No notice in the newspapers of such a comet having been seen and noted, the ladies were filled with enthusiasm to be, as they supposed, its first discoverers."

"Monday night the comet was found to be near the feet of the Great Bear, and much diminished in brilliancy, proving that it was rapidly receding from the earth."

It seems desirable, for the sake of cometary history, to give the following translation of a note by M. Tisserand in *Comptes Rendus*, No. 3.

"On the 10th July last, in the morning, I received a telegram from M. Quénisset, of the staff of the Juvisy Observatory, announcing that he had the previous night, the evening of the 9th July, discovered a bright comet, visible to the naked eye, whose approximate co-ordinates he gave. I at once transmitted a telegram to Kiel. The following morning, July 11, there came a telegram from Kiel, announcing that the comet had been seen on July 8 at Utah, U.S.A. by Mr. Rordame. It is therefore certain that Mr. Rordame has discovered the comet, but that M. Quénisset has announced it first. Perhaps it will be convenient to call it the Rordame-Quénisset comet; there are analogous precedents."

COMET FINLAY (1886 VII.).—The following is the ephemeris of this comet for the present week:—

12h. *Paris Mean Time.*

1893.	R.A. (app.) h. m. s.	Decl. (app.) ° ′ ″
July 27 ...	5 1 13·6 ...	+21 47 39·8
28 ...	5 26·9 ...	21 56 13·6
29 ...	9 38·5 ...	22 4 19
30 ...	13 48·3 ...	22 11 56·4
31 ...	17 56·2 ...	22 19 6·1
Aug. 1 ...	22 2·4 ...	22 25 48·6
2 ...	26 6·6 ...	22 32 4·6
3 ...	5 30 9·0 ...	22 37 54·4

CHANGES IN THE SPECTRUM OF β LYRÆ.—At the Pulkova Observatory, the new spectroscope has been adapted to the large refractor, and among many of the stellar photographs already obtained several are of β Lyræ, the changes in which are described by Belopolsky in the June number of the *Memorie della Società degli Spettroscopisti Italiani*. The measures of position of the lines were made relatively to the solar lines by superposing a solar spectrum on that of the star. A general examination of the plates showed the following details, the most remarkable lines being D_3, 501·4μμ, 492μμ, F, 471μμ, 448μμ, 447μμ. F consisted nearly always of two brilliant rays, one of which would disappear or become very dim, and between these could occasionally be seen a dark line; in the vicinity of F occasionally is seen also another dark line. The analysis of the changes in the bright F line indicates that its duplicity depends on one or both of the dark lines, or in other words, that we have here a case of superposition of the bright and dark lines. The period is nearly of 13 days' duration. At the principal minimum of the star, the bright F becomes single, the dark lines being situated one on the edge and the other alone. At the maximum, F becomes double, but the component on the violet side is very thin. At secondary minimum, F is double and symmetrical. Little change takes place at the following maximum, the component on the red side being a little thinner than the other; after this maximum it becomes a dark line.

With regard to the dark F line, M. Belopolsky says that this seems to consist of two, but it is seldom that they are separated; it is suggested that a second ray may mask the changes in wave length of the other, thus accounting for the irregular changes.

The Helium line undergoes two changes; sometimes it disappears altogether, while at other times it appears double. Its period of duplicity is put down as 7 days. The group 448-447μμ is defined as very complicated, and presents the same changes as the F lines, consisting of dark and bright lines and changing their positions like the components of the F lines. This paper is accompanied by a diagram showing the positions of the star in the curve of brightness at the time of exposure, and also by copies of several of the spectra.

THE VARIABLE STAR Y CYGNI.—Among recent papers on variable stars, that by Prof. N. C. Dunér on the elements of the variable star Y Cygni is of great importance. (*Kongl: Vetenskaps Akademiens Forhandlinger*, 1892, No. 7). This star is of the Algol type, and its variation is limited nearly exclusively to a small portion of its period during which it descends in a few hours to a minimum, to regain in about the same time its ordinary brightness. Since its discovery by Chandler in 1886, it has been very constantly observed, and it is perhaps on this account that Prof. Dunér can give such a complete story. Considering the odd and even minima separately, he deduces a formula which gives very small values for the residuals obtained from the observed minus calculated times, and to put it shortly he is led to the conclusion that the star Y Cygni consists of two stars of equal magnitude and brightness, moving in an elliptic orbit, the plane of which passes through the sun, and whose line of apsides makes an angle with the line of sight. The time of revolution is 2 days 23 hours, 54 minutes, 43·26 seconds. Prof. Dunér, at the latter end of this paper, gives the ephemeris and tables of interpolation of the times of the odd and even epochs in Paris mean time.

NEW DETERMINATION OF THE CONSTANT OF UNIVERSAL ATTRACTION.—A new and original method of determining the mass and density of the earth was described in our issue of July 13 (p. 251).

The following further information on the same subject is interesting. The first experiments gave for the value of K—the constant of gravitation—

$$K = 6{\cdot}80 \times 10^{-8}.$$

Determining the mass of the earth, by substituting this value of K in the formula

$$g\mu = K.\ \frac{\mu M}{R^2}$$

when M and R represent the mass and radius of the earth respectively, and where

$$g = 981 \text{ and } R = 6{\cdot}37 \times 10^8 \text{ centimetres},$$

the value obtained was

$$M = 5{\cdot}85 \times 10^{27} \text{ grammes},$$

whence the density of the earth was found to be

$$D = 5{\cdot}41.$$

We here enumerate the different values that we possess with regard to the earth density—

Plumb-line at Schiehallien (Maskelyne and Playfair)	4·713	
,, Arthur's Seat (James)	5·316	
Pendulum at Mont Cenis (Carlini and Giulis) . .	4·94	
,, Harton Coal Pit (Airy)	6·565	
Torsion-Balance (Cavendish, 1798)	5·48	
,, (Reich, 1838)	5·49	
,, (Baily, 1843)	5·66	
,, (Cornu and Baille, 1872)	5·5	-5·56

THE CORONAL ATMOSPHERE OF THE SUN.—Prof. Janssen, in *Comptes Rendus*, No. 2, for July 10, communicates an interesting note on the history of facts which have demonstrated the existence of the coronal atmosphere of the sun.

VARIABLE STARS.—In the *Astronomical Journal*, No. 299, M. Paul Yendell publishes more observations of the maxima and minima of variable stars. Among some of those referred to are Y Ophiuchi, X Cygni, T Vulpecellæ, X, W, Y, and U Sagittarii.

GEOGRAPHICAL NOTES.

THE *Times* has received the following telegram from Dr. Nansen, dated Berlevaag, July 21. Berlevaag is about sixty miles west of Vardö, on the north coast of Norway:—"We are leaving Vardö for Yugor Strait (between Waigatz Island, south of Nova Zembla, and the coast of Russia), where thirty sledge dogs will be waiting for us. We then proceed along the Siberian coast eastward past Cape Chelyuskin to the Olenets river, near the Lena, where another twenty-six dogs will be waiting for us. We then turn northwards, and hope to reach the west coast of the New Siberian Islands in the end of August if the ice is not bad. The latest information about the ice conditions in that quarter is favourable. We then proceed direct northwards until we get fast in the ice. If we meet with new land we shall follow along its west coast northwards. When there is no more open water we shall allow the *Fram* to drift with the ice. Everything has gone on well up to the present. The *Fram* is a splendid strong ship and will stand the ice-pressure well. She is deeply laden with coal, but that is a drawback which will soon be remedied. The accounts of the ice in the White Sea and the Barents Sea are not favourable. There has been much ice, but hope it has now improved; the ice changes quickly. I have good hopes; if we only get through the Kara Sea in good time I feel certain the prospects of success are good.—FRIDTJOF NANSEN."

THE July number of the *Geographical Journal* commences the second volume. Amongst other papers of interest there is one of some importance on South-west Africa by Count Pfeil, who has taken a leading part in settling the interesting German colony at Windhoek, east of Walfisch Bay. Regarding Port Nolloth, he points out the curious fact that the great waggon traffic set up by the copper mines of Ookiep has led to the uprooting for fuel of all the little bushes which formed the sole vegetation of the country. The light soil deprived of its protection has changed into drifting sand, and there is no prospect of this artificial desert being redeemed by natural agencies.

IN the last number of the *Scottish Geographical Magazine* there is an abstract of an important paper by Prof. H. Wagner on the teaching of geography in Germany, which gives an admirable *résumé* of the growth to university rank of that study, the adequate recognition of which is confined to Germany, and the true proportions of which have never yet been realised in this country.

IN the *Asiatic Quarterly Review* Prof. Sayce shows that the term Sinaitic peninsula applied to the region between the Gulfs of Suez and Akaba is a misnomer; all the evidence available proving that Mount Sinai really stands somewhere in the ranges of Mount Seir, the exact site being still unknown.

SOME RECENT RESTORATIONS OF DINOSAURS.

IF palæontologists are apt to be discouraged by the apparent hopelessness of ever arriving at a satisfactory conclusion as to the structure and affinities of some of the fossil vertebrates with which they have to deal, they ought assuredly to take fresh confidence from the marvellous advance which has taken place of late years in our knowledge of the organisation of those huge extinct reptiles commonly known as Dinosaurs. It was, indeed, as far back as 1824 that the carnivorous genus *Megalosaurus* was first made known to us by Buckland, from specimens obtained in the Great Oolite of Oxford, while the following year saw the first announcement by Mantell of the now well-known *Iguanodon* from the Sussex Wealden. These early pioneers in this branch of palæontology necessarily had, however, but a faint conception of the real structure, and still less of the morphological importance of the group of reptiles whose former existence they were the first to reveal. It was long, indeed (in spite of the efforts of anatomists like Cuvier, Owen, and Huxley), before the riddle of the structure of the pelvis of the *Iguanodon* was solved, the final solution being given by Mr. J. W. Hulke in a paper read before the Geological Society on June 9, 1875, and published in the following year. The appearance of this paper may be said, indeed, to mark the commencement of the epoch of rapid advance in our knowledge of Dinosaurs, for only two years afterwards (1878) was issued the first of Prof. O. C. Marsh's important series of memoirs on the American Jurassic Dinosaurs, from which it appears that the true nature of the Iguanodont pelvis had been independently discovered in America. About the same time that the first of the American palæontologist's memoirs saw the light the scientific world was startled by Monsieur E. Dupont's announcement of the discovery of numerous entire skeletons of Iguanodons in fissures of the Belgian coal-fields. And this unexpected and fortuitous discovery enabled Monsieur L. Dollo to publish in April, 1883, the completely restored skeleton of one of these monsters in its natural attitude.

Although as far back as 1861, Sir R. Owen had described the greater portion of a Dinosaurian skeleton from the Dorsetshire Lias, M. Dollo's figure was the first complete restoration of the skeleton of a Dinosaur based on actual specimens. Scarcely, however, had this figure appeared when Prof. Marsh (August, 1883) gave us the restoration of the entire skeleton of an American Dinosaur (*Brontosaurus*), of still more stupendous bulk than the *Iguanodon*, and belonging to a group hitherto but very imperfectly understood. From that date till 1891 (although much important work on the group was being done) there seems, however, to have been a lull in the work of Dinosaurian restoration, no foreign worker having apparently made any attempts at further complete restorations of the skeletons of these reptiles. In the United States specimens both from the Jurassic and the newly explored Cretaceous strata were, however, steadily accumulating; and during that year Prof. Marsh published restorations of the skeletons of two forms, which for strangeness and uncouthness exceed the wildest flights of the imagination.

In glancing at some of the more striking features of these different Dinosaurian restorations, we may remind our readers that Dinosaurs may be divided into three main groups, of which the first is represented by the Brontosaur (Fig. 1), the second by the Megalosaur, of which an authentic restoration has but recently been published, while in the third we have two sub-groups, one of which is typified by the Iguanodon (Fig. 5), and the other by *Hypsirophus* (Fig. 3).

In the first, or crocodile-like group (Sauropsida), we have the least specialised forms (Fig. 1), all of which were habitually four-footed, and distinguished by their solid limb-bones, and the excavation of the sides of the bodies of most of their vertebræ by large cavities, which may have been filled with air in the living condition. The pelvis, as will be seen from our figure, is of a comparatively normal structure, with a relatively short anterior process to the upper bone or ilium,[1] and with the lower bones known as the pubis and ischium respectively inclined forwards and backwards after the crocodilian fashion. Our figure is taken from Prof. Marsh's restoration of 1883, in which the skull is imperfect, but in a later figure given by the Professor the head is fully restored, with the characteristic spoon-like teeth in position. In referring to this restoration Prof. Marsh observes that "the diminutive head will first attract attention, as it is smaller in proportion to the body than in any other reptile hitherto known. The neck was very long and flexible. The body was rather short. The legs and feet were massive, and the bones all solid. The tail was very long and powerful. The animal during life must have been nearly sixty feet in length, and about fifteen feet in height. Its probable weight was more than twenty tons. *Brontosaurus* was herbivorous in habit, and its food was probably aquatic plants or other succulent vegetation. The skeleton here represented was found in the Upper Jurassic, in Wyoming, west of the Rocky Mountain range."

We may add that the first known members of this group were discovered in British strata, the Cetiosaurus having been described from the great oolite by Owen, in 1842, and the *Pelorosaurus* by Mantell, in 1850, on the evidence of a stupendous humerus from the Wealden. The fragmentary and disassociated condition of the English specimens rendered it, however, quite impossible to refer with certainty the various teeth, vertebra, and limb-bones to their respective owners until we had the American skeletons as a standard for comparison, and even with that advantage we are not altogether clear on these points. There is, moreover, still some degree of doubt as to the right of some of the American forms to be separated generically from their European allies.

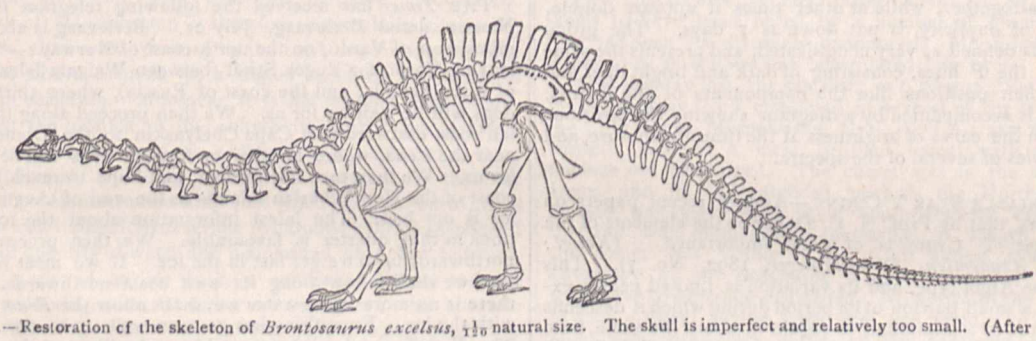


FIG. 1.—Restoration of the skeleton of *Brontosaurus excelsus*, $\frac{1}{150}$ natural size. The skull is imperfect and relatively too small. (After Marsh.)

Till 1892 we had no fully authentic restoration of the skeleton of any of the larger members of the Carnivorous, or Megalosaurian group; but this want has been supplied by Prof. Marsh, from whose figures the accompanying illustration (Fig. 2) has been reproduced. It will be seen that, with the exception of the anterior vertebræ of the back, the skeleton is nearly complete; and since the missing vertebræ are known from European specimens, there can be no doubt as to their general form. On account of the presence of bony protuberances on the skull of the species figured, as well as from certain other peculiarities, such as the soldering together of the bones of the pelvis and metatarsus, Prof. Marsh regards the American form as generically distinct from the European *Megalosaurus*, and has accordingly suggested for it the name of *Ceratosaurus*. We are persuaded, however, that Prof. Cope is right in regarding the two as generically inseparable.

Passing on to the third or bird-footed (Ornithopodous) group of these reptiles, we come to some of the most specialised forms, none of which attain, however, the stupendous dimensions reached by some of the first group. The more typical representatives of this third assemblage are characterised, it need

[1] For these bones, see Fig. 3.

scarcely be said, by the generally bird-like arrangement of the pelvis, in which the front part of the ilium is much produced forwards, while the pubis has its main shaft (when present) directed backwards alongside of the ischium in a bird-like fashion (Fig. 3), and also giving off an anterior process which must not be confounded with the main shaft of the pubis of the Brontosaur (Fig. 1). The bird-footed Dinosaurs are subdivided into the armoured and the typical sections, of which the former has but lately been fully made known to us.

As our first example of the former, we take the skeleton of the Jurassic *Hypsirophus* represented in Fig. 3. The existence of this type of Dinosaur was first revealed by the discovery in 1875 of a considerable portion of a skeleton (now in the British Museum) in the Kimeridge clay of Swindon, which was described by Sir R. Owen during the same and following years under the name of *Omosaurus*;—a term which unfortunately proved to be a preoccupied one. This skeleton comprised many of the vertebræ and limb-bones together with some long spines similar to those represented at the end of the tail in Fig. 3. The skull is, however, missing, and there are no traces of the huge plates of bone shown in the restoration. If, however, we imagine the body of the reptile to which this skeleton pertained to have been drifting in the water sufficiently long to have lost its head by the action of decomposition, there is nothing more probable than that the row of plates along the back should have likewise disappeared. From 1877 onwards Prof. Marsh has been gradually completing our knowledge of allied reptiles from the upper Jurassic of Colorado and Wyoming, to which he applied the name *Stegosaurus*, but which appear to have been previously described by Prof. Cope under the title of *Hypsirophus*. First we had descriptions of some of the vertebræ and limb-bones, with isolated specimens of the plates and spines of the armour; then we had the head; and finally we are favoured with the restoration shown in the figure, which is certainly that of a most marvellous monster. The Professor tells us that this restoration is based on a specimen which "had the skull, skeleton and dermal armour together when entombed, and almost in the position they were when the animal died. . . . In this restoration the animal is represented as walking, and the position is adapted to that motion. The head and neck, the massive fore-limbs, and, in fact, the whole skeleton indicate slow locomotion on all four feet. The longer hind limbs and the powerful tail show, however, that the animal could thus support itself as on a tripod, and this position must have been easily assumed in consequence of the massive hind-quarters. . . . . The neural spines of the vertebræ have their summits expanded to aid in supporting the massive dermal armour above them. The limb-bones are solid, and this is true of every other part of the skeleton. The feet were short and massive, and the terminal phalanges of the functional toes were covered by strong hoofs. There were five well-developed digits in the fore foot, and only three in the hind foot, the first toe being rudimentary, and the fifth entirely wanting."

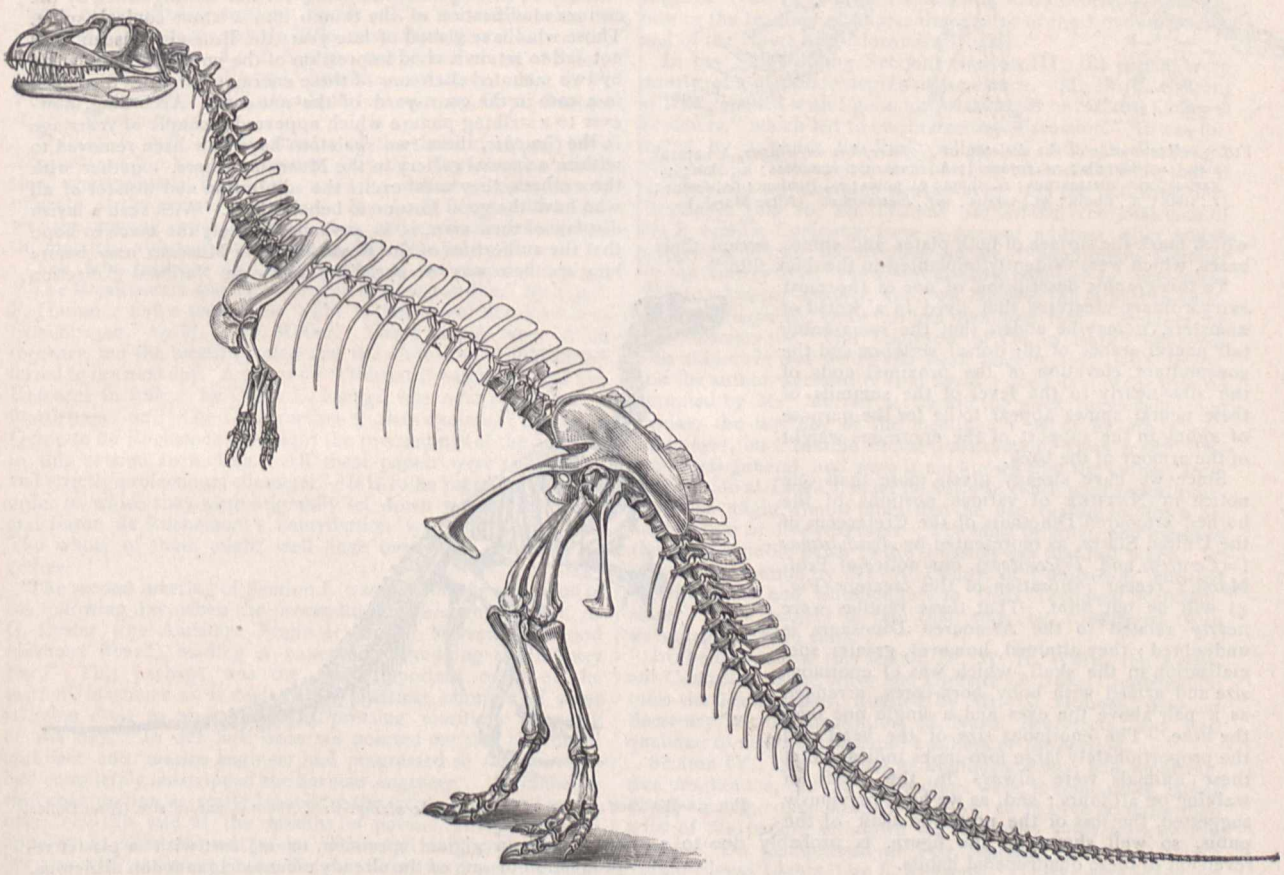


Fig. 2.—Restoration of a skeleton of a Carnivorous Dinosaur, $\frac{1}{30}$ natural size. (After Marsh.)

"In life the animal was protected by a powerful dermal armour, which served both for defence and offence. The throat was covered by a thick skin, in which was embedded a large number of rounded ossicles, as shown in the figure. The gular portion represented was found beneath the skull, so that its position in life may be regarded as definitely settled. The series of vertical plates extended above the neck, along the back, and over two-thirds of the tail is a most remarkable feature, which could not have been anticipated, and would hardly have been credited had not the plates themselves been found in position. The four pairs of massive spines characteristic of the present species, which were situated above the lower third of the tail, are apparently the only part of this peculiar armour used for offence. In addition to the portions of armour above mentioned, there was a pair of small plates

just behind the skull, which served to protect this part of the neck."

"All these plates and spines, massive and powerful as they now are, were in life protected by a thick horny covering, which must have greatly increased their size and weight. This covering is clearly indicated by the vascular grooves and impressions

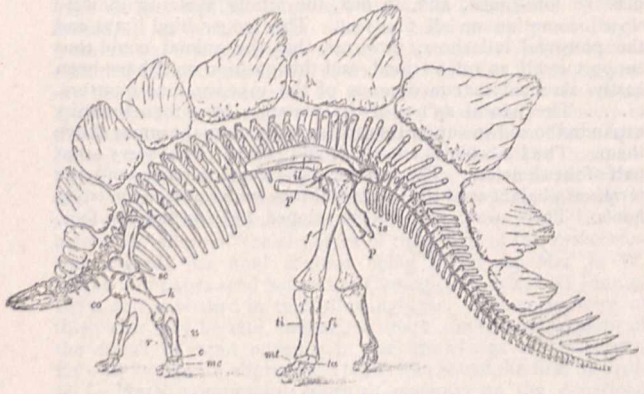


FIG. 3.—Restoration of the skeleton of *Hypsirophus ungulatus*, $\frac{1}{50}$ natural size. *sc.*, scapula; *co.*, coracoid; *h.*, humerus; *r.*, radius; *u.*, ulna; *c.*, carpus; *mc.*, metacarpus; *il.*, ilium; *p.*, pubis; *is.*, ischium; *fe.*, femur; *t.*, tibia; *fi.*, fibula; *ta.*, tarsus; *mt.*, metatarsus. (After Marsh.)

which mark the surface of both plates and spines, except their bases, which were evidently implanted in the thick skin."

To this graphic description of one of the most extraordinary creatures that lived in a world of monsters, it may be added that the remarkably tall neural arches of the dorsal vertebræ and the concomitant elevation of the proximal ends of the ribs nearly to the level of the summits of their neural spines appear to be for the purpose of aiding in the support of the enormous weight of the armour of the back.

Since we have already given more than one notice in NATURE of various portions of the horned armoured Dinosaurs of the Cretaceous of the United States, as represented by *Agathaumas* (= *Ceratops* and *Triceratops*), our notice of Prof. Marsh's recent restoration of this creature (Fig. 4) will be but brief. That these reptiles were nearly related to the Armoured Dinosaurs is undoubted; they attained, however, greater specialisation in the skull, which was of enormous size and armed with bony horn-cores, arranged as a pair above the eyes and a single one over the nose. The enormous size of the head and the proportionately large fore limbs indicate that these animals were always in the habit of walking on all fours; and, as we have previously suggested, the loss of the posterior shaft of the pubis, so well shown in the figure, is probably due to a reversion to these quadrupedal habits.

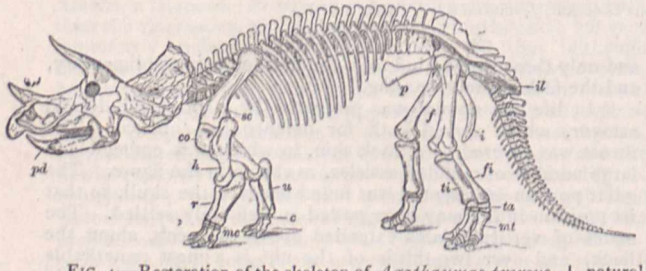


FIG. 4.—Restoration of the skeleton of *Agathaumas prorsus*, $\frac{1}{50}$ natural size. Letters as in Fig. 2. (After Marsh.)

In regard to this restoration Prof. Marsh remarks that "the skull is, of course, without its strong horny covering on the beak, hon-cores and posterior crest, and hence appears much smaller than in life. The neck seems short, but the first six cervical vertebræ are entirely concealed by the crest of the skull, which in its complete armature would extend over one or two vertebræ more. . . . . No attempt is made in this restoration to represent the dermal armour of the body, although in life the latter was more or less protected. Various spines, bosses, and plates, indicating such dermal armour, have been found with remains of this group, but the exact position of these specimens can at present be only a matter of conjecture. . . . . The size in life would be about twenty-five feet in length and ten feet in height."

The extraordinary contrast between the skeletons of *Agathaumas* and *Brontosaurus* will be sufficiently apparent from a comparison of the respective figures.

The typical section of the bird-footed Dinosaurs, as represented by the Iguanodons (Fig. 5) is now so well known that but few remarks are necessary. They differ from the armoured forms in their perfect adaptation to a bi-pedal mode of progression, their digitigrade feet, hollow limb-bones, and absence of armour; the Iguanodons being further distinguished by the curious modification of the thumb into a stout conical spine. Those who have visited of late years the Brussels Museum will not fail to retain a vivid impression of the imposing show made by two mounted skeletons of these enormous reptiles displayed in a case in the court-yard of the museum. According, however to a striking picture which appeared a couple of years ago in the *Graphic*, these two skeletons have now been removed to within a special gallery in the Museum, where, together with three others, they must excite the admiration and wonder of all who have the good fortune to behold them. With such a lavish display of their own, it is, perhaps, scarcely too much to hope that the authorities of the Royal Brussels Museum may before long see their way to enriching our own National Collection

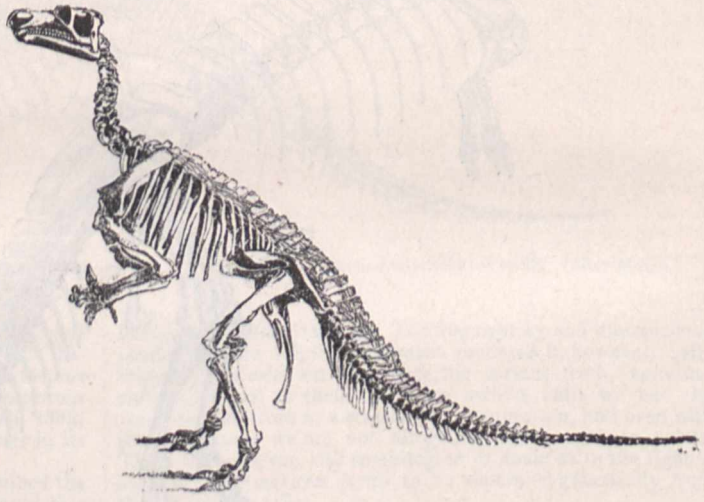


FIG. 5.—Restored skeleton of *Iguanodon bernissartensis*. About $\frac{1}{75}$ natural size. (After Dollo.)

either with an original specimen, or at least with a plaster reproduction of one of the already mounted Iguanodon skeletons.

Although there is no lack of work remaining to be done among the Dinosaurs, yet when we reflect that practically our whole definite knowledge of the group dates from within the last twenty years, and that all the five restorations at which we have glanced have been made within the last ten, we cannot but fail to be gratified at the enormous progress that has been made by this branch of palæontology within that comparatively short period. If this progress cannot be justly entitled to be termed one advancing by "leaps and bounds," yet we think that it may, on the whole, be truly described as "slow and sure."

R. LYDEKKER.

THE INTERNATIONAL MARITIME CONGRESS.

DURING nearly the whole of last week a most important congress was being held in London at the Institution of Civil Engineers. This was the International Maritime Congress, an institution founded in Paris in 1889, when no less than

twenty-two papers on various maritime subjects were read and discussed, and visits were made to some of the most important seaports on the north and west coasts of France. The international commission, which constitutes the executive, determined that the second meeting of the congress should be held this year in London, and as a result the first sitting took place on July 18, when the opening proceedings were got through in the morning by the delivery of various complimentary addresses, whilst in the afternoon the more serious business of the congress commenced.

The proceedings were divided into four sections, as follows :—

Section I. Harbours, Breakwaters, &c.
,, II. Docks and their Equipment.
,, III. Shipbuilding and Marine Engineering.
,, IV. Lighthouses, Fog-signals, &c.

There were in all over forty papers set down for reading and discussion, and all but a few were so disposed of, only one or two being taken as read. Such a feat speaks highly of the industry of the various sections, and it will be understood that in this general notice we can do little more than give a list of the various papers read. Lord Brassey was president of the congress, and Mr. James Forrest, honorary secretary. Mr. C. F. Findlay was secretary. The headquarters were 25, Great George-street, Westminster.

Section I. met in the theatre of the Institution of Civil Engineers at 2 p.m., on Tuesday, July 18. It should be stated that arrangements had been made for different chairmen to officiate at the various meetings. Mr. L. F. Vernon-Harcourt was the moving spirit in this section, and naturally presided at the meetings although he did not occupy the chair.

The first business was the reading of two papers, one on "The Breakwaters and Harbours of Middlegrunden," by Capt. P. Hansen ; and a second on "The Harbour and Breakwater of Copenhagen," by H. C. V. Möller. These papers were taken together, but the meeting voted that the discussion should be deferred to the next day. A paper on "Recent Breakwaters and Sea Defences in Italy," by Chev. L. Luiggi, was next read ; and a fourth paper on "The Construction of Breakwaters," by Baron Quinette de Rochemont, brought the proceedings of the first day in this section to a close. All these papers were of a special and strictly professional character. It is to be regretted that the order in which they were originally set down was not followed, and Baron de Rochemont's contribution was not taken first. The whole of them might well have been then discussed together.

The second meeting of Section I. was held on the afternoon of the following day, when the proceedings were opened by Mr. A. G. Lyster (the Assistant Engineer of the Mersey Dock and Harbour Board) reading a paper on "Dredging the Mersey Bar." This perhaps was the most important paper of the section, inasmuch as it dealt with a practical example of what is being done to meet the most pressing maritime necessity of the day. In our last issue we pointed out that the naval architect and marine engineer had progressed so far that they had completely outstripped the harbour engineer. Advance in ship construction is really barred by the want of depth of water over dock-sills and at the mouths of ports. This is not only apparent in cross-channel service with small swift packet boats, but also with our great ocean liners. Every increase in size in steamships appears to be attended by success, but limits of draught seem now to stop progress in this direction. A paper by M. Feret on mortar in sea works was also read at this sitting ; a paper by MM. Cimino and Verdinois on rock-dredging at Palermo being taken as read.

The next sitting of Section I. was on the following Thursday afternoon, when three papers were set down for reading. The first taken was by M. P. Demey on ports on sandy coasts ; the second, by M. V. E. de Timonoff, a Russian Professor, having a similar title. The latter contribution was an interesting communication of a general nature, in which the various points involved in the consideration of the subject in regard to tideless seas were considered at large. In the discussion an interesting point was raised by an English engineer, Mr. Wheeler, as to the movement of beach. The matter was perhaps somewhat outside the legitimate scope of the discussion, as Mr. Wheeler attributed the movement of beach to the tidal movement, whilst M. de Timonoff dealt only with tideless seas. Mr. Wheeler said that the travel of beach is always in the direction of the flood—a theory which does not support the author's line of argument ; but it must again be said the action of tide was eliminated from the author's reasoning. A paper by Mr. C. Spadon on the Lido entrance to the port of Venice was taken as read.

The last sitting of Section I. was held on Friday afternoon. Two papers were on the list, one by Mr. A. E. Carey on "La Guaira Harbour Works, Venezuela," and a second, "Harbours and Ferry Systems of Denmark," by the same author.

In Section II. the first meeting was held on Wednesday morning, when the following papers were down for discussion : —"The Docks of Bordeaux," by H. Crahay de Franchemont ; "The Equipment and Working of Ports," by A. Guerard ; "The New Docks of Antwerp," by G. A. Rogers ; and "Hydraulic Installation at the Port of Genoa," by L. Luiggi and E. Borgatti. The next sitting was on the following day, when three other papers were read, viz. :—"The Port of Calais," by A. Charguérand ; "The Port of Dunkirk," by Paul Joly ; and "Lengthening of Leghorn Dry Dock," by J. Inglese. The last day of the meeting was devoted by this section to the reading of papers descriptive of the London Docks, and of the Havre and Alexandra Docks.

In the Shipbuilding Section, Section III., the papers were mostly of a moderate degree of excellence. Mr. A. E. Seaton, of Hull, opened with a good historical paper on "Cross Channel Steamers," which led to an interesting discussion. It was followed by a paper by Prof. Biles, on "Ocean Passenger Steamers." The subject has been so often dealt with, that it is difficult to say anything new upon it. On the following day, Thursday, July 20, Sir Thomas Sutherland, the chairman of the P. and O. Company, gave a general address, after which a paper by Mr. A. Blechynden, on the "Sand-pump Dredger for the Mersey Bar," the vessel already referred to, was read. This is a hopper dredger, and, we believe, the largest in existence, the capacity being no less than 3000 tons. A paper by Mr. Flannery on "The Transport of Oil in Bulk" followed. The subject is one which has been largely dealt with lately, and the author necessarily trod again a good deal of the ground occupied by Mr. Martell at Cardiff the week previously. On Friday, the last day of the meeting, a paper by Mr. C. E. Stromeyer, on "Marine Boiler Construction," was read. The scope was general, and were it not known that the author, from his position at Lloyd's, must be fairly in touch with recent practice, one might almost fancy that he had ceased to study his subject four or five years ago. The most original, and perhaps the most suitable paper to the occasion was that last taken. It was a contribution by Mr. A. Denny, of Dumbarton, entitled "Shipowners and Shipbuilders in their Technical Relationships." The subject is one that may be considered with advantage by both sides.

In the business of this section Dr. W. H. White, the Assistant-Controller of the Navy and Director of Naval Construction, took the leading part, assisted by Mr. G. Holmes, who, as Secretary to the Institution of Naval Architects, was well qualified to conduct the detail business of the section.

Section IV., that devoted to lighthouses, &c., had an attractive programme, but the proceedings were, in some cases, rather disappointing. Our space will allow us to give no more than a list of the papers set down for reading. They were as follows :—"On Compressed-air Fog Signals," by C. Ribière ; "Ship Signal Lights," by J. Kenward. These were taken on the first day, Tuesday, July 18th. A discussion was brought on by arrangement upon "Communication between Lightships and the Shore." The result was disappointing on the whole. The next day a good paper on "Feux-Éclairs, and the Physiological Perception of Instantaneous Flashes" was contributed by M. A. Blondel. M. Bourdelles also gave a paper on "Methods and Formulæ for Calculating the Luminous Power of Lighthouse Apparatus." The following day an interesting and practical paper on "The Illumination of Estuaries and Rivers" was contributed by Mr. W. T. Douglass. Two other papers were on the list for this day, the first on "Harbour Lights, Buoys, and Beacons in Italy," by D. Lo Gatto, and another on "Researches as to Continuous and Alternate Electrical Currents for Lighthouse Purposes," by A. Blondel. The last day of the meeting had three papers down for reading, viz. : "On Recent Improvements in Lighthouses," by D. A. Stevenson ; "Efficiency of Recent Gigantic Lighthouse Apparatus compared with Electric Light," by D. Lo Gatto ; and "Lighting and Light Dues in the Red Sea," by Commander G. Hodgkinson, R.N.

In connection with the Congress there were numerous dinners

and other festivities, at which the foreign members were the lions of the occasion; indeed, international courtesy reigned throughout the proceedings. This was carried so far in one section that hardly anything but French was spoken, those who wished to take part in the discussions receiving but little encouragement from the chair unless they addressed the meeting in the French tongue—or, rather, in French words. This was satisfactory to the majority, so far as the remarks of foreign members were concerned; but when the language was exotic in its character to follow was sometimes laborious. This week a series of excursions are being made to some of the chief ports of the United Kingdom.

THE LUMINIFEROUS ETHER.

AT the anniversary meeting of the Victoria Institute on June 29, Sir G. G. Stokes delivered his presidential address. After a few introductory remarks on the functions of the Institute, he said:—"I intend to bring before you to-night a subject which the study of light has caused me to think a good deal about: I refer to the nature and properties of the so-called luminiferous ether. This subject is, in one respect, specially fascinating, scientifically considered. It lies, we may say, in an especial manner on the borderland between what is known and what is unknown. In the study of it it is quite conceivable that great discoveries may be made, and, in fact, great discoveries have already been made, and I may say even quite recently, and we do not at present know how much additional light on the system of Nature may be in store for the men of Science; possibly even in the near future, possibly not until many generations have passed away. I will assume, as what is familiarly known to you all, and what is well established by methods into which I will not enter, that the heavenly bodies are at an immense distance from our earth. More especially is this the case with the fixed stars. Their distance is so enormous that even when we take as a base line, so to speak, the diameter of the earth's orbit, which we know to be about 184 millions of miles, the apparent displacement of the stars due to parallax is so minute as almost to elude our investigation. Nevertheless that distance is more or less accurately determined in the case of a few of the fixed stars. But the vast majority, as we have every reason to believe, are at such an enormous distance that even this method fails with them."

"To give a conception of the immense distance of the fixed stars, I will assume as known that light travels at the rate of about 186,000 miles in one second, a rate which would carry it nearly eight times round and round the earth in that time; and yet if we take the star which, so far as we know, is our nearest neighbour, it would take three or four years for light from that star to reach the earth. Now as we see the fixed stars there must be some link of connection between us and them in order that we should be able to perceive them. Probably all of you know that two theories have been put forward as to the nature of light, as to the nature accordingly of that connection of which I have spoken. According to one idea, light is a substance darted forth from the luminous body with an amazing velocity; according to the other, it consists in a change of state taking place, propagated through a medium, as it is called, intervening between the body from which the light proceeds and the eye of the observer. For a considerable time the first of these theories was that chiefly adopted by scientific men. It was that, as you know, which Newton himself adopted; and probably the prestige of his name had much to do with the favourable reception which for a long time it received. But more recent researches have so completely established the truth of the other view, and refuted the old doctrine of emissions, that it is now universally held by scientific men that light consists in an undulatory movement propagated in a medium existing in all the space through which light is capable of passing."

"This necessity for filling all space, or at least, such an inconceivably great extent of space, with a medium, the office of which, so far as was known in the first instance, was simply that of propagating light, was an obstacle for a time to the reception by the minds of some of the theory of undulations. Men had been in the habit of regarding the inter-planetary and inter-stellar space as a vacuum, and it seemed too great an assumption to fill all this supposed vacuous space with some kind of medium for the sole purpose of transmitting light. Notwithstanding, even long ago strong opinions were entertained to the effect that there must be something intervening between the different heavenly bodies. In a letter to Bentley, Newton expresses himself in very strong language to this effect: 'That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance through a *vacuum*, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe that no man who has in philosophical matters a competent faculty of thinking, can ever fall into it. Gravity must be caused by an agent acting constantly according to certain fixed laws; but whether this agent be material or immaterial, I have left to the consideration of my readers.'"

"What the nature of the connection between the earth and the sun, for example, may be whereby the sun is able to attract the earth and thereby keep it in its orbit—in other words, what the cause of gravitation may be—we do not know; for anything we know to the contrary, it may be connected with this intermediate medium or luminiferous ether. There are other offices, we believe, which this luminiferous ether fulfils, to which I shall have occasion to allude presently."

"In connection with the necessity for filling such vast regions of space with this medium, a curious question naturally presents itself. We cannot conceive of space as other than infinite, but we habitually think of matter as occupying here or there limited portions of space, as, for example, the different heavenly bodies. The intervening space we commonly think of as a vacuum, and it is only the phenomena of light that led us in the first instance to think of it as filled with some kind of material. The question naturally presents itself to the mind—is this ether absolutely infinite like space? This is a question to which science can give no answer. Though we cannot help thinking of space as infinite, yet when we turn our thoughts to some material existing in space perhaps we more readily think of it as finite than infinite. But if the ether, however vast the portion of space over which it extends, be really limited, we can hardly fail to speculate what there may be outside its limits. Space there might be wholly vacuous, or possibly outside altogether this vast system of stars and ether there may be another system subject to the same laws, or subject to different laws, as the case may be, equally vast in extent; and if there be, then so far as we can gather from such phenomena as are open to our investigation, there can be no communication between that vast portion of space in part of which we live and an ideal system altogether outside the ether of which we have been speaking."

"But the properties of the ether are no less remarkable than its vast or even possibly limitless extent. Matter of which our senses give us any cognisance is heavy, that is to say, it gravitates towards other matter which agrees with it in so far as being accessible to our senses. The question presents itself to the mind, does the ether gravitate towards what we call ponderable matter? This is a question to which we are not able to give any positive scientific answer. If the ether be in some way or other connected with the cause of gravitation, it would seem more likely that it itself does not gravitate towards ponderable matter."

"Again, we have very strong reason for believing that ponderable matter consists of ultimate molecules. First, that supposition accords in the simplest way with the laws of crystallography. Chemical laws afford still stronger confirmation of the hypothesis, through the atomic theory of Dalton, now universally accepted. Comparatively recently, the deduction of the fundamental property of gases from the kinetic theory, as it is called, affords strong additional confirmation of that view of the constitution of matter. Still more recently, the explanation which has been afforded by that theory of that most remarkable instrument the radiometer of Crookes has lent further confirmation in the same direction. None of these evidences apply to the ether, and accordingly we are left in doubt whether it too consists of ultimate molecules, or whether on the other hand it is continuous, as we cannot help conceiving space to be."

"The undulatory theory of light was greatly promoted in the first instance by the known phenomena of sound, and the explanation which they received from the hydrodynamical theory. Accordingly, since sound, as we know, consists of an undulatory movement propagated through the air (or it may be through other media), and depending upon condensation and rarefraction, it was supposed naturally that light was propagated in a

similar manner, by virtue of the forces brought into play by the condensation and rarefraction of the ether. But there is one whole class of phenomena which have actually no counterpart in those of sound; I refer to polarisation and double refraction."

"The evidence for the truth of the theory of undulations as regards the phenomena of common light depends in great measure upon the fact of interference and the explanation which the theory gives of the complicated phenomena of diffraction. But in studying the interference of polarised light, additional phenomena presented themselves which ultimately pointed out that the vibrations with which we are concerned in the case of the ether differ altogether in their character from those which belong to sound. The phenomena of the interference of polarised light prove incontestably that there exists in light an element of some kind having relation to directions transverse to that of propagation, and admitting of composition and resolution in a plane perpendicular to the direction of transmission according to the very same laws as those of the composition and resolution of forces, or velocities, or displacements in such a plane. This requires us to attribute to the ether a constitution altogether different from that of air. It points out the existence of a sort of elasticity whereby the ether tends to check the gliding of one layer over another. Have we no example of such a force in the case of ponderable matter? We have. We know that an elastic solid, which for simplicity I will suppose to be uncrystalline, and alike in all directions, has two kinds of elasticity, by one of which it, like air, tends to resist compression and rarefraction; while by the other it tends to resist a continuous gliding of one portion over another, and to restore itself to its primitive state if such a gliding has taken place. There is no direct relation between the magnitude of these two kinds of elasticity, and in the case of an elastic solid such as jelly the resistance to compression is enormously great compared to the resistance to a gliding displacement."

"If we assume that in the ether there is really an elasticity tending to restore it to its primitive condition when one layer tends to glide over another, an elasticity which it appears to be absolutely necessary to admit in order to account for the observed laws of interference of polarised light, the question arises, can we thereby explain double refraction?"

"The earliest attempts to explain it in accordance with the theory of transverse vibrations were made by attributing to the ether a molecular constitution more or less analogous to that which we believe to exist in ponderable matter. Following out speculations founded upon that view, the celebrated Fresnel was led to the discovery of the actual laws of double refraction; the theory, however, which he gave was by no means complete, inasmuch as the results were not rigorously deduced from the premises. Cauchy and Neumann, independently and about simultaneously, took up Fresnel's view of the constitution of the ether and applied it to explain the laws of double refraction. In their theory the conclusions arrived at were rigorously derived from the premises; but the results did not altogether agree with observation; that is to say, although they could by the adoption of certain suppositions be forced into a near accordance with the observed laws of double refraction, yet they pointed out the necessity of the existence of other phenomena which were belied by observation. Our own countryman Green was the first to deduce Fresnel's laws from a rigorous dynamical theory, although nearly simultaneously MacCullagh arrived at a theory in some respects similar, though on the whole I think less satisfactory."

"Still all these theories followed pretty closely the analogy of ponderable matter; and at least in the first three mentioned the ether was even imagined to consist of discrete molecules, acting on one another, like the bodies of the solar system regarded as points, by forces in the direction of the joining line, and varying as some function of the distance. I have already quoted the very strong language in which Newton rejected the idea of the heavenly bodies acting on one another across intervening spaces which were absolutely void. But the conception has nothing to do with the magnitude of the intervening spaces; and the conception of action at a distance across an intervening space which is absolutely void, is not a bit easier when the space in question is merely that separating two adjacent molecules, when the ether is thought of as consisting of discrete molecules, than it is when the space is that separating two bodies of the solar system, though in this latter case it may amount to many millions of miles. If the ether be in some unknown manner the link of connection whereby two heavenly bodies are enabled to exert on one another the attraction of gravitation, then according to the hypothetical constitution of the ether that we have been considering, we seem compelled to invent an ether of the second order, so to speak, to form a link of connection between two separate molecules of the luminiferous ether. But since the nature of the ether is so very different as it must be from that of ponderable matter, it may be that the true theory must proceed upon lines in which our previous conceptions derived from the study of ponderable matter are in great measure departed from."

"If we think of the ether as a sort of gigantic jelly, we can hardly imagine but that it would more or less resist the passage of the heavenly bodies—the planets for instance—through it. Yet there appears to be no certain indication of any such resistance. It has been observed indeed in the case of Encke's comet, that at successive revolutions the comet returned to its perihelion a little before the calculated time. This would be accounted for by the supposition that it experienced a certain amount of resistance from the ether. Although at first sight we might be disposed to say that such a resistance would retard perihelion passage, yet the fact that it would accelerate it becomes easily intelligible, if we consider that the resistance experienced would tend to check its motion, and so prevent it from getting away so far from the sun at aphelion, and would consequently bring it more nearly into the condition of a planet circulating round the sun in a smaller orbit."

"Many years ago I asked the highest authority in this country on physical astronomy, the late Prof. Adams, what he thought of the evidence afforded by Encke's comet for the existence of a retarding force, such as might arise from the ether. He said to me that he thought we did not know enough as to whether there might not possibly be a planet or planets within the orbit of Mercury which would account for it in a different way. But quite independently of such a supposition it is worthy of note that the remarkable phenomena presented by the tails of comets render it by no means unlikely that even without the presence of a resisting medium, and without the disturbing force arising from the attraction of an unknown planet situated so near to the sun as not to have been seen hitherto, the motion of the head of a comet might not be quite the same as that of a simple body representing the nucleus, and being subject to the gravitation of the sun and planets and nothing else. It appears that the tails consist of some kind of matter driven from the comet with an enormous velocity by a sort of repulsion emanating from the sun. If the nucleus loses in this manner at each perihelion passage an exceedingly small portion of its mass, which is repelled from the sun, it is possible that the residue may experience an attraction towards the sun over and above that due to gravitation, and that possibly this may be the cause of the observed acceleration in the time of passing perihelion even though there be no resistance on the part of the ether. So that the question of resistance or no resistance must be left an open one."

"The supposition that the ether would resist in this manner a body moving through it is derived from what we observe in the case of solids moving through fluids, liquid or gaseous, as the case may be. In ordinary cases of resistance, the main representative of the work apparently lost in propelling the solid is in the first instance the molecular kinetic energy of the trail of eddies in the wake. The formation of these eddies is, however, an indirect effect of the internal friction, or if we prefer the term viscosity, of the fluid. Now the viscosity of gases has been explained on the kinetic theory of gases, and in the case of a liquid we cannot well doubt that it is connected with the constitution of the substance as not being absolutely continuous but molecular. But if the ether be either non-molecular, or molecular in some totally different sense from ponderable matter, we cannot with safety infer that the motion of a solid through it necessarily implies resistance."

"The luminiferous ether touches on another mysterious agent, the nature of which is unknown, although its laws are in many respects known, and it is applied to the every-day wants of life, and its applications are even regulated by Acts of Parliament; I allude to electricity. I said that the nature of electricity is unknown. More than forty years ago I was sitting at dinner beside the illustrious Faraday, and I said to him that I thought a great step would have been made if we could say of electricity something analogous to what we say of light, when we affirm that light consists of undulations; and he said to me that he thought we were a long way off that at present. But, as I said, relations

have recently been discovered between light and electricity which lead us to believe that the latter is most closely connected with the luminiferous ether."

"Clerk-Maxwell showed that the ratio of two electrical constants which are capable of being determined by laboratory experiments, and which are of such a nature that that ratio expresses a velocity, agrees with remarkable accuracy with the known velocity of light. This formed the starting-point of the electro-magnetic theory of light which is so closely associated with the name of Maxwell."

"According to this idea, light may be looked on as the propagation of an electro-magnetic disturbance, whatever the appropriate idea of such a thing may actually be. The theory has quite recently received remarkable confirmation by the investigations of Hertz, who has shown that what are incontestably electro-magnetic disturbances, and are investigated by purely electrical means, exhibit some of the fundamental phenomena of light, such, for example, as interference and polarisation. It appears that these electro-magnetic waves are strictly of a similar nature to the waves of light, though there is an enormous difference in the scale of wave-lengths, which in the case of light range about the $\frac{1}{50000}$th part of an inch, while the electro-magnetic waves which have been investigated by purely electrical methods range from a few inches to many yards."

"I have ventured to bring this interesting subject before you in the course of the address which I have just delivered. I have not attempted to lay before you the evidence on which scientific men rely for the truth of the conclusions which I have mentioned as well established. That would have required, not merely an evening address, but a whole course of lectures. Neither have I made any allusion to possible bearings of the scientific conclusions on questions relating to religious beliefs. Anything of that kind I leave to your own minds; my object has been simply to present to you very briefly the conclusions of science in that limited branch which I have selected, distinguishing as impartially as I could what is well established from what is debatable or even merely conjectural."

THE NATURE OF DEPOLARISERS.[1]

WHEN an electric current is passed between plates of platinum through a solution of sulphuric acid, the hydrogen and oxygen are partly retained at the surfaces—and apparently also within the plates—and under these conditions are capable of interacting, as in the well-known Grove gas battery: so that in so far as the "gases" thus circumstanced are concerned the change may be expressed by a reversible equation. This reversal constitutes the well-known phenomenon termed polarisation by physicists.

Reversal owing to the retention of hydrogen in circuit is promoted to different extents by different metals—hence apparently the varying electromotive forces of single fluid cells containing different negative plates; and when the pressure is sufficient to retain the whole of the hydrogen at the plate, it becomes total—hence it is, for example, that zinc does not dissolve in sulphuric acid under great pressure.

Various substances known generally as depolarisers are used to prevent the accumulation of products of electrolysis and the consequent reversal of the action—such as copper sulphate in the case of the Daniell cell and "nitric acid" in the case of the Grove and Bunsen cells; but whereas the action of copper sulphate is easy to understand, that of "nitric acid" offers many difficulties. As the heat of dissolution of copper in dilute sulphuric acid is a negative value (about 12,000 units), the displacement of copper by hydrogen—*i.e.* the heat of dissolution of hydrogen in copper sulphate—is a positive value, so that not only does the presence of the copper sulphate prevent the accumulation of hydrogen, but in removing hydrogen it also serves to increase the electromotive force of the cell from about 37/46ths to about 50/46ths of a volt. The principle underlying this is extensible even to cases in which one part of the cumulative effect of the cycle of change is a negative value. Thus, although copper has a negative heat of dissolution, it will readily dissolve in dilute sulphuric acid if it be used in place of zinc in a Grove cell, the negative heat of dissolution of copper being more than compensated for by the positive heat of dissolution of hydrogen in "nitric acid"; and it is well known that copper dissolves in many weak acids in presence of oxygen. It is easy to understand how oxygen acts in such cases, but the facts show that the effect produced by "nitric acid" is not so readily interpreted, and their consideration raises important questions of general application.

Russell has shown that when "nitric acid" is freed from nitrous compounds it does not dissolve silver, but that action sets in when a trace of nitric oxide is introduced, and continues with increasing rapidity as the quantity of the nitrous compound—a necessary product of the action—increases; Veley's later experiments have shown that the same is true of copper, without, however, affording any further explanation of the phenomena. Although it is not to be expected that such metals would dissolve in nitric acid even when coupled with a relatively electronegative conductor, as they have negative heats of dissolution, yet if the acid also acted as depolariser a cycle might be formed in which sufficient energy would be developed to condition change: it therefore follows that in such cases *nitric acid* does not act as the depolariser in accordance with the equation: $2Ag + 2NO_3H + ONO_2H = 2AgNO_3 + H_2O + NO_2H$, and that in point of fact the nitrous compound is the depolariser, although the nitric acid is the actual solvent of the metal, the hydrogen of the acid being virtually directed displaced by the metal with the assistance, however, of the current energy derived from its own oxidation by the nitrous compound.

But what interpretation is to be given of the behaviour of more active metals, such as zinc, magnesium, &c., which have positive heats of dissolution, and therefore are capable of dissolving in the pure dilute acid if coupled with a relatively negative conductor; does nitric acid in their case directly act as a depolariser? If it be capable of thus acting, such metals even when uncoupled should dissolve in the pure diluted acid. It is noteworthy that when such metals are dissolved in nitric acid hydrogen is sometimes evolved. It has been suggested that this hydrogen is derived from the interaction of the metal and water, but I cannot now regard this as a probable explanation; its production serves rather to suggest a deficiency of the depolarising agent, which cannot well occur if nitric acid be the depolariser. Indeed, if nitric acid be regarded as directly active, it is remarkable that in presence of the large excess of the acid which is always present any hydrogen should escape; and also that the reduction should extend so far as it often does, and not extend merely to the formation of nitrous acid. If, however, the acid be incapable of directly acting as a depolariser, and a nitrous compound be the initially active depolarising agent, it is no longer surprising that owing to the nitrous compound suffering further reduction it should be deficient in parts of the circuit, and that consequently hydrogen should escape. Why the reduction should extend so much further when metals having positive heats of dissolution are used, however, still requires elucidation.

In the case of sulphuric acid, whatever metal be dissolved in the *diluted* acid, no reduction takes place; and it is only when the concentrated and more or less heated acid is used that sulphurous oxide and other reduction products are obtained. It appears not improbable that reduction only takes place under conditions under which the presence of sulphuric *oxide* is possible, *i.e.* that depolarisation is effected by sulphuric *oxide* and never by sulphuric *acid*, although this latter may be regarded as the actual solvent of the metal. There is at present no evidence forthcoming to show that nitric acid can dissociate into the anhydride and water, and even if such a change took place in concentrated solutions, there is no reason to assume that it can also take place in dilute solutions, and that this is the explanation of the difference between nitric and sulphuric acids. It is well known, however, that nitric acid is resolved with extreme facility into nitrogen dioxide, water and oxygen, and that it is excessively sensitive to the action of nitric oxide—a trace of nitric oxide would therefore exercise a fermentative action and condition, the formation, it may be, of nitrous acid, or—as there is no evidence compelling us to suppose that the compound represented by the formula HNO_2 exists—it may be of nitrogen dioxide. In this latter case, solutions of nitric acid would resemble concentrated sulphuric acid in containing a reducible oxide, and it may be that their depolarising action is initially exerted through such an oxide alone.

To arrive at a clear conception of the function of acids in dissolving metals, and of the nature of depolarising agents, it would therefore appear to be necessary to take into account many circumstances to which hitherto but little attention has been paid.

HENRY E. ARMSTRONG.

[1] Reprinted from the Proceedings of the Chemical Society, No. 125.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN a letter to the *Times* of July 25, Mr. J. Parker Smith, M.P., describes the action that has been taken by Wykehamists with a view of commemorating the 500th anniversary of the opening of Winchester College by some permanent memorial. It was resolved last May that any fund which might be raised should be applied, first, to the restoration of the Founder's Chantry in the Cathedral, and secondly, to establishing a group of memorial buildings for the preservation of Wykehamical antiquities and the encouragement of art, archæology, natural history, and other sciences. Mr. Smith is the Chairman of the Executive Committee formed to administer the funds, and he says that the aims of the collection of archæology and art would be to illustrate and encourage the regular course of school study, and to furnish boys with interests outside that course. As to science, the idea is that the science collections should be a development of the present collection of the Natural History Society, which is good though not large. Mr. Smith thinks that special stress would doubtless be laid on the collection of local minerals, fauna, and flora. An attempt might also be made (as has been done at Harrow) to imitate the admirably instructive series of type forms exhibited in the Museum of Natural History at South Kensington; and it would be highly desirable to connect some moderate provision for elementary biological and botanical work with the natural history museum. Contributions to the fund will be received by the hon. secretary, Mr. Percy R. T. Toynbee, 109, Gloucester Terrace, Hyde Park, W.

THE sixth annual meeting of the National Association for the Promotion of Technical and Secondary Education was held on July 24. The Duke of Devonshire, who occupied the chair, said that public funds had been so rapidly secured for purposes of technical instruction that in some cases both county councils and municipal authorities were at a loss to decide upon the best means of administering them. He thought that it might be advisable for another Royal Commission to be appointed to inquire and report upon the progress made since 1881 in our own and in Continental countries. He was glad to see that the county councils of Staffordshire, Bedfordshire, and Manchester had sent their organising secretaries to the Continent to ascertain the latest developments of technical education abroad, and hoped that their example would be followed by others. Sir Henry Roscoe presented the report of the Society, and its adoption was moved by Mr. Mundella, and supported by Sir F. S. Powell. The officers of the Society were re-elected, with the addition of Sir W. Hart-Dyke as a vice-President, and Sir A. Rollit as a member of the executive committee.

AS an outcome of the Technical Instruction Act, a scheme was promoted, and plans subsequently adopted, for the erection of technical schools at Maidstone, and the foundation stone of the new buildings has just been laid. The schools, which are commodious and well adapted for the purpose for which they will be used, have received the sanction of the Science and Art Department, and comprise, on the ground floor, science, lecture, and class rooms—the former capable of seating from sixty to eighty-four students—large lecture hall, and a library, together with physical and chemical laboratories, and a wood-carving workshop. On the first floor is the art school, with painting and modelling rooms, and a life studio. The basement is designed for an electric installation and stores. There being a large available space in the vicinity of the Maidstone Museum, the new buildings will form an adjunct, and both in the science and art departments direct communication may be had with that institution, which will thus mutually further the objects of the whole group.

THE following alterations, among others, have been introduced into the programme of techniological examinations of the City and Guilds of London Institute for the session 1893-94. 1. An examination in cabinet-making and one in metal-work as a branch of manual training have been added. 2. The syllabus in boot and shoe manufacture has been divided into two grades, and separate practical tests are added to each grade. 3. The honours examination in photography is divided into two sections—(1) pure photography and (2) photo-mechanical processes—and the practical examination will be held in connection with the honours grades only. 4. The examination in cotton weaving in the ordinary grade is divided into two sections—(1) plain weaving and (2) fancy weaving. 5. An examination preliminary to that in the ordinary grade will be held in electric lighting and in typography; and the examination in typography in the ordinary grade is divided into two sections. 6. The syllabus in silk weaving is enlarged so as to include riband weaving. 7. The syllabuses in cloth weaving, flax spinning, hosiery, goldsmiths' work, brickwork, and in other subjects have been revised.

DR. DENDY, who for the past five years has held the position of demonstrator and assistant lecturer in biology in the University of Melbourne, has been appointed lecturer in biology at the Canterbury College, in the University of New Zealand, and will enter upon his duties there in February next. At present Dr. Dendy has sole charge of the biological department during the absence of Prof. Spencer in England.

MR. STANLEY DUNKERLY, M.Sc., has been appointed assistant-lecturer in engineering at the Walker Engineering Laboratories, University College, Liverpool.

LAST year the Staffordshire Technical Education Committee sent a number of teachers to Leipzig for a course of manual training in wood-work, iron-work, &c., at Dr. Gotze's Institute. The plan is again being followed this year, not only in Stafford but by other counties that have come to recognise its usefulness.

SCIENTIFIC SERIALS.

American Journal of Science, July.—The following are among the papers appearing in this number:—Studies of the phenomena of simultaneous constrast colour; and on a photometer for measuring the intensities of lights of different colours, by Alfred M. Mayer. The photometer was constructed in such a manner that the two tints to be compared were reduced to the same by the effects of contrast. Two discs, 13cm. in diameter, and having half of their surface removed in the shape of eight equidistant sectors, were made of thin Bristol board. Between them was placed a circle of white translucent tracing paper, and the discs were clamped together with the open sectors coinciding. The compound disc was mounted on a rotator and placed opposite two silvered mirrors inclined at an angle of 150°. The plane of the disc bisected the angle formed by the mirrors, so that the surfaces of both sides could be seen simultaneously. On rotating the disc while illuminated by daylight on the one side and by lamplight on the other, the side illuminated by daylight appeared white tinted with yellow, the other appeared white tinted with blue. A compound disc of red lead, of chrome yellow, and of white cardboard was placed on the daylight side, and an ultramarine, emerald green and white disc on the lamplight side. The greenish-blue produced by the latter combination made the light blue on the lamplight side appear faintly orange-yellow by contrast, while on the other side of the ring the orange-yellow disc had diminished the orange-yellow tint of the ring to the same feeble orange-yellow as seen on the other side.—On the ammonium-lead halides, by H. L. Wells and W. R. Johnston, and on the rubidium-lead halides, and a summary of the double halides of lead, by H. L. Wells. The authors are of opinion that not one of the many complicated ammonium-lead halides described by André really exists, but that the bodies obtained by him were mixtures. They themselves succeeded in preparing five salts representing three different proportions of ammonium and lead.—A one-volt standard cell, by Henry S. Carhart. This is a calomel and zinc chloride cell adjusted to an E.M.F. of one volt by a proper concentration of the zinc chloride solution. In the bottom of the tube is pure mercury in contact with platinum wire; then follows a paste of mercurous chloride and zinc chloride held in position by a cork diaphragm; and finally an amalgamated zinc rod immersed in zinc chloride solution of density 1·391 at 15°C. The cell has a small positive temperature coefficient.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Influence of Exercise on the Interchange of the Respiratory Gases," by W. Marcet, M.D., F.R.S.

The following is a summary of the contents of this paper:—

1st. It was shown that in three persons out of four who

submitted to experiment there was a great tendency to an uniformity of figure for the oxygen *consumed* under similar physical circumstances (food, temperature, &c.), so that, if the CO_2 expired fell, the oxygen absorbed rose, and *vice versâ*; this was accounted for by assuming that an increase of CO_2 in the blood in the state of repose is produced at the expense of the O absorbed. The fourth person experimented upon exhibited no such tendency, the CO_2 expired and O absorbed rose and fell together, which was ascribed to the fact that he was still growing.

2nd. Experiments were made on the influence of exercise on respiration, which showed that if stepping exercise (stepping at the rate of sixty-eight times per minute) is taken after a period of rest, there occurs for a few minutes an accumulation of CO_2 in the blood; of course the storage of CO_2 after exercise must be controlled by the normal amount of CO_2 produced in repose, and the kind of exercise taken; this storage would in the cold winter weather, and between one and two hours after food, continue for about eighteen or twenty minutes. In my case the volume of CO_2 retained in the blood amounted to a mean of 500 c.c. while stepping sixty-eight times per minute. The CO_2 in store is next given out in the form of a wave, which is renewed after a certain lapse of time, so that there does not appear to be in respiration under exercise a fixed relation between the CO_2 expired and the CO_2 left in the blood With practice and training this relation would probably become more and more uniform.

The storage of CO_2 in winter and after food was found to exhibit a certain relation to the excess of CO_2 expired under exercise over the CO_2 expired in repose; but eighteen or twenty minutes after exercise had been commenced this relation failed to show itself any longer.

The ratio in question was the same with two different persons; but further experiment is required to determine whether this ratio can be looked upon as general; the mean relation found is shown by the figure 0·123; therefore, so far as the present inquiry goes, by multiplying this figure 0·123 by the excess of CO_2 given out per minute under exercise over the CO_2 expired in repose during the same lapse of time, the result will show the volume of CO_2 absorbed in the blood per minute.

3rd. After the exercise adopted in this inquiry had been followed by a complete repose of ten minutes, the CO_2 expired had returned to the normal in repose, but the volume of O absorbed per minute had considerably fallen, apparently owing to the blood having charged itself with oxygen during exercise, so that the first few minutes after rest was taken, the blood was in a condition to supply oxygen for tissue-changes without taking it from the air breathed at the time. After half an hour's perfect rest following exercise the respiratory changes had returned to their normal state of repose, or nearly so, the oxygen absorbed still occasionally showing signs of being a little lower than before exercise had been taken.

June 15.—"On a Graphical Representation of the Twenty-Seven Lines on a Cubic Surface." By H. M. Taylor, Fellow of Trinity College, Cambridge. Communicated by A. R. Forsyth, F.R.S.

The converse of Pascal's well-known theorem may be stated thus: if two triangles be in perspective, their non-corresponding sides intersect in six points lying on a conic. An extension of this theorem to three dimensions may be stated thus: if two tetrahedrons be in perspective, their non-corresponding faces intersect in twelve straight lines lying on a cubic surface. This theorem may be deduced from the equation

$$xyzu = (x + a\mathrm{T})\,(y + b\mathrm{T})\,(z + c\mathrm{T})\,(u + a\mathrm{T}),$$

where $\mathrm{T} = \alpha x + \beta y + \gamma z + \delta u$; and $a, b, c, d, \alpha, \beta, \gamma, \delta$ are constants. The equations of twelve lines on the surface are evident.

This paper shows how the remaining fifteen straight lines on the surface may be obtained by means of nothing higher than quadratic equations, and determines which of these lines intersect each other.

The paper then proceeds to give a graphical method of representing all the intersections of the twenty-seven lines on a cubic surface by means of a plane diagram, which admits of many interesting transformations.

By the help of such diagrams some of the known relations of the twenty-seven lines to each other are deduced, and some theorems with respect to the lines which it is believed are new are established; for instance, the number of closed quadrilaterals, pentagons, and hexagons on the surface is determined, as well as the number of ways in which nine triple tangent planes can be drawn to pass through all the twenty-seven lines, and the number of ways in which twelve of the lines can be chosen, so that they are the intersections of two tetrahedrons in perspective.

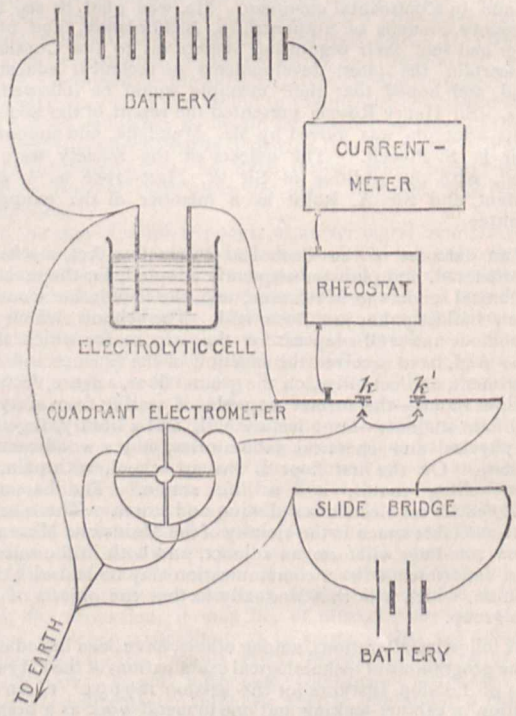
"Polarisation of Platinum Electrodes in Sulphuric Acid." By James B. Henderson, B.Sc. Communicated by Lord Kelvin, P.R.S.

This investigation was begun about the beginning of February, 1893, at the instigation of Lord Kelvin, and was conducted in the Physical Laboratory of Glasgow University. The object of the investigation was to obtain the difference of potential between two platinum electrodes immersed in a solution of sulphuric acid immediately after the stoppage of a current which had been electrolysing the solution, and to find how this difference varied with a variation in the intensity of the current or in the strength of the solution.

Former experiments by Buff and Fromme have given for the maximum polarisation with platinum wires of very small surface in the electrolysis of dilute sulphuric acid 3·5 and 4·6 volts.

Dr. Franz Richarz says of the above:—"In these experiments the polarisation is calculated from measurements of the intensity of the galvanic current during the electrolysis, tacitly assuming that the resistance of the decomposition cell is independent of the intensity of the galvanic current. The correctness of the supposition has not been proved." By employing a different method he found values for the polarisation never greater than 2·6 volts with small wire electrodes, and also got the same maximum with large platinum plates.

The electrodes in the present investigation were rectangular plates of platinum foil 7 cm. long by 5·5 cm. broad, and were immersed in the solution to a depth of 5 cm., having their planes parallel, and about 1 cm. apart. There were thus 55 sq. cm. of surface of each plate wetted. To find the polarisation one of Lord Kelvin's Quadrant Electrometers was used. The method used can be best understood from the diagram. By means of



the key k the breaking of the electrolysing current circuit and the switching of the electrodes on to the terminals of the electrometer were done simultaneously. Before switching as above, however, the needle of the electrometer was deflected by keeping the key k' down, thereby making a difference of potential between the pairs of quadrants equal to that between the slider and the earthed end of the high resistance slide bridge, and this

deflection was adjusted by trial and error, so that when *k* was pressed no further deflection took place. To secure this, at the beginning of an experiment, the slider was placed so that when *k* was momentarily pressed, the deflection of the electrometer needle was increased impulsively. The amount of this impulsive deflection was noted, and the slider moved so as to increase the steady deflection nearly up to the point on the scale reached by the impulsive one, and then another trial was made. In this way, by watching the point reached by each impulsive deflection, and then increasing the steady one almost up to that point, the latter was increased until the former vanished—that is, until the potential of the quadrants was that of polarisation. The magnitude of this deflection was then noted and the polarisation calculated from it.

All the results point to the polarisation being constant with large electrodes, being independent of the strength of the solution and the intensity of the current. The results of one series of experiments are given in the accompanying table. The variations in the figures do not occur in any order, and are all such as might be expected in experimental results of this nature. Some of the greatest variations were obtained in exactly similar experiments performed at different times.

Percentage strength of solution.	Strength of current in ampères.	Time the current had been passing.	Polarisation in volts.
		h. m.	
30	0·2	3 25	2·066
,,	0·5	0 45	2·060
,,	1·0	0 35	2·060
,,	1·0	0 45	2·124
20	0·1	3 22	2·126
,,	0·5	1 25	2·139
,,	1·0	0 25	2·090
,,	1·0	0 35	2·124
10	0·1	17 40	2·139
,,	0·5	1 19	2·066
,,	1·0	0 44	2·066
5	0·1	18 30	2·116
,,	0·5	1 36	2·078
,,	1·0	1 0	2·083
,,	1·0	3 15	2·054

Mean olarisation = 2·09 volts.

"On the Displacement of a Rigid Body in Space by Rotations. Preliminary Note." By J. J. Walker, F.R.S.

Having been led to study more particularly than, as far as I am aware, has hitherto been done the conditions of the arbitrary displacement of a rigid body in space by means of rotations only, the results arrived at in the case of the single pairs of axes seem to me of sufficient interest and completeness to warrant their being recorded.

A comparison of these results with those arrived at by Rodrigues in his classic memoir "Des lois géométriques qui régissent les déplacements d'un système solide dans l'espace . . . ." Liouville, vol. v. 1840, at once suggesting itself, it may be proper here to recall the substance of the latter, and show how far they fall short of the object I propose to myself. The case of displacement by successive rotations round a pair of axes is discussed in § 13 (pp. 395-396), where it is shown that (p. 390), "Tout déplacement d'un système solide peut être représenté d'une infinité de manières par la succession de deux rotations de ce système autour de deux axes fixes non convergents. Le produit des sinus de ces demi-rotations multipliés par le sinus de l'angle de ces axes et par leur plus courte distance, est égal, pour tous ces *couples* d'axes *conjugués*, au produit du sinus de la demi-rotation du système autour de l'axe *central* du déplacement, multiplié par la demi-translation absolute du système."

Then (p. 396) the converse of this theorem is affirmed, viz., that "*Tout déplacement . . . peut toujours provenir, d'une infinité de manières, de la succession de deux rotations autours de deux axes non-convergents* pourvu que *le produit*. . . ."

In this conversion of the theorem above, it is strangely overlooked that a displacement is not defined by the direction of axis, and amplitude, of the resultant rotation, together with the magnitude of the component of the corresponding translation along that direction (for in this form the proof is given, the axis being drawn through one end of the common perpendicular to the particular couple in respect of which the theorem is demonstrated), since these elements are common to an infinity of displacements.

These being premised, the laws connecting pairs of axes by successive rotations round which a given displacement of a rigid body in space may be effected are as follows:—

If the first axis is taken parallel to a given vector, ζ', there are four directions, to any one of which (ζ) its conjugate may be parallel, viz., the sides common to two quadric cones, the constants of which are functions of ζ' and the vectors defining the displacement.

One of these cones, whatever the direction of ζ', passes through the vector which is the axis of resultant rotation for the origin, or, in other words, which is parallel to the *central* axis for the given displacement. The other cone (K) passes through a vector covariant with ζ', say ζ_1.

The direction ζ' and any selected one of the four vectors ζ being taken for a pair of axes of rotation, the corresponding amplitudes are thus determined, viz. that of the second rotation is double the angle between the planes of the vectors ζ, ζ' and ζ, ζ_1. And as, ζ being fixed, ζ' lies on two cones, one of which, K′, contains a side (ζ'_1) corresponding to the side ζ_1 of K, the angle of rotation round the first axis is double that between the planes of the vectors ζ', ζ and ζ', ζ'_1. The planes of ζ, ζ_1 and ζ', ζ'_1 meet in the vector parallel to the central axis.

The directions of the axes being fixed in accordance with the above conditions, the locus of either axis is a plane, the places of the axes in which are so related that the connector of the feet of perpendiculars on them from any fixed point generates a ruled quadric surface.

As regards the *reality* of the conjugates (ζ) corresponding to an arbitrary direction (ζ') assumed for the first axis, it may suffice here to state that one real conjugate, at least, is insured by taking as ζ' any side of the quadric cone which is defined by replacing ζ in the cone K with the vector parallel to the *central* axis. The two cones, whose common sides are directions of the corresponding conjugate, then both passing through that vector, will meet in at least one other real side.

PARIS.

Academy of Sciences, July 17.—M. de Lacaze-Duthiers in the chair.—On the discovery of the comet *b* 1893, by M. F. Tisserand.—Expression of the resistance offered by each ponderable molecule to the vibratory motion of the ambiant ether, by M. J. Boussinesq.—On the generalisation of a theorem of Euler relating to polyhedræ, by M. H. Poincaré.—Experiments on the resistance of air and diverse gases to the motion of bodies, by MM. L. Cailletet and E. Colardeau. The experiments previously made on the resistance of air to the motion of falling bodies, and performed at the Eiffel Tower, led to varying results according to the pressure of the atmosphere. In order to determine the influence of the pressure upon the resistance, and also that of the nature of the gas, the apparatus was enclosed in a cast-iron receiver of 300 litres capacity, into which air or other gas could be pumped up to pressures of 8 or 10 atmospheres. The apparatus consisted of a paddle-wheel set in motion by a weight suspended by a string wound upon the shaft. A double cock, with intermediate reservoir, permitted the introduction of a known quantity of shot into the cylindrical hollow of the driving weight, so as to increase the weight without affecting the pressure. A key, worked from the outside through a stuffing-box, enabled the experimenters to replace the weight as often as desired without loss of compressed gas. The downward motion of the weight became uniform as soon as the resistance of the gas equalled the driving weight. An electric contact inside the receiver connected with a bell outside indicated the rate of rotation of the paddle-wheel. The resistance opposed by any gas to the motion of a plane was found to be proportional to its surface, the square of its velocity, and the pressure and density of the gas. If two planes are placed one behind the other at a distance equal to their breadth, the total resistance is about 1·1 times that offered to a single plane. Placing two planes 0·15 m. broad 1 m. apart, the sum of their resistances did not come up to twice the resistance of each.—Observations of the new comet Rordame, made with the great equatorial of the Bordeaux Observatory, by MM. G. Rayet and L. Picart.—On a relation which exists between the formulæ of Coulomb (magnetic), Laplace, and Ampère, by M. E. H. Amagat. It is shown that W. Weber's method of arriving at the values of the constants of Ampère's

formula is incorrect. M. Amagat hopes shortly to obtain some more accurate results.—On glycolysis in normal and diabetic blood, by MM. R. Lépine and Métroz. In diabetic blood the absolute loss of sugar *in vitro*, although quite perceptible, is very much less than it would be if the glycolytic energy were normal; it is, therefore, evident that the glycolytic energy must be lowered.—On the new comet *b* 1893, by M. Quénisset.—Observations of the new comet, *b* 1893, made at the Paris Observatory (west equatorial), by M. G. Bigourdan.—On studies of the discharge of vapour through orifices, by M. H. Parenty.—On the simplicity of samarium, M. Eug. Demarçay. From experiments upon solutions of samarium salts it appears that the suspicions entertained as to its elementary nature were unfounded.—On cyclic condensations of carbon, by M. Gustave Rousseau. M. Rousseau succeeded in preparing artificial black diamonds by the decomposition of calcium acetylide in a current of moist gas in a Ducretet electric furnace. Some of the grains obtained were 0·5 mm. in diameter.—On aminobutenediamide and butanonediamide, by M. R. Thomas-Mamert.—On the saturation of the nitrogens of nicotine and on an acetyl nicotine, by M. A. Étard.—Rotatory powers of quinic acid derivatives, by M. S. G. Cerkez.—Derivatives and constitution of rhodinol and essence of roses, by M. Ph. Barbier.—Laws of evolution of digestion; their interpretation, by M. J. Winter.—Does the elasticity of the muscle diminish during contraction? by M. N. Wedensky.—On the mechanism of the production of light in the *Orya barbarica* of Algiers, by M. Raphael Dubois.—On the pelagic fauna of the lakes of the French Jura, by MM. Jules de Guerne and Jules Richard.—On a parasitic fungus of *Cochylis*, by MM. C. Sauvageau and J. Perraud.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* from January 18 to April 12 contain the following papers of scientific interest:—

January 18.—E. Riecke: Thermodynamics of tourmaline, and the mechanical theory of muscular contraction; a criticism of Müller's hypothesis. H. Weber: Researches in the theory of numbers in the domain of elliptic functions, I.

January 25.—A. Peter: Contributions to our knowledge of the *Hieracea* of Eastern Europe. I. The *Piloselloidea* of the Moscow district. P. Drude: The relation of the dielectric constants to indices of refraction. The following theorem is obtained: "The difference between the dielectric constant and the square of the refractive index is equal to the sum of the polarisation-constants of the molecular groups whose free vibrations lie in the ultra-red." W. Voigt: Observations on the torsional rigidity of rocksalt prisms. W. Voigt: Observations on the tensile strength of rock crystal and fluorspar. F. Klein: The composition of binary quadratic forms. H. Weber: On the theory of invariants. D. Hilbert: On the transcendency of the numbers e and π.

February 8.—E. Ritter: Automorphic algebraic forms of arbitrary species.

AMSTERDAM.

Royal Academy of Sciences, June 24.—Prof. van de Sande Bakhuyzen in the chair.—Mr. Kamerlingh Onnes gives the results of some experiments made in the Leyden Laboratory (1) by Dr. Kuenen, on the surface of v. d. Waals for mixtures. One of the phases observed by Wroblewski in compressing air with CO_2, and by Prof. Dewar in compressing CS_2 with CO_2 is due to insufficient mixing. (2) By Dr. Siertsema, on the magneto-optic dispersion of oxygen. The apparatus used is like that of Kundt and Röntgen, but the polariser and analyser are Nicols', and the coil is magnetised by a dynamo of 8 h.p. The magnetic rotation of the plane of polarisation diminishes regularly as the wave-length increases.—Mr. J. A. C. Oudemans communicated some remarks concerning Sir John Herschel's second method of calculating the most probable orbit of a binary star, (Mems. of the R.A.S., vol. xviii.). The apparent orbit is here determined analytically by applying the method of least squares to the solution of the equations

$$\alpha x + \beta y + \gamma x^2 + \delta xy + \epsilon y^2 + 1 = 0,$$

where α, β, γ, δ, ϵ are the unknown quantities, x, y the co-ordinates given by the normal places. Sir John gave these equations equal weights, whereas the speaker proved that the weight of each equation $= p = \frac{1}{P^2 + Q^2}$, P being $= \alpha + 2\gamma x + \delta y$, and $Q = \beta + \delta x + 2\epsilon y$. In the example given by Sir John (the orbit of γ Virginis) p varies from the single to the treble. If the weight of a normal place is estimated, from other considerations (*i.e.* the power of the telescopes, the number of observations, &c.), $= p'$, the weight of the corresponding equation is to be taken $= pp'$. Mr. Franchimont asserts the possibility that glucose, being aldehyde and alcohol together, would, by the known interaction of these two functions, *i.e.* an addition, give in some circumstances derivatives of a tautomeric form, an oxide, whenever this does not exist in the free state. In such a tautomeric form (the most probable is 1·2) there is one asymmetric carbon atom more than in the aldehydic form, and he inclines to consider the two pentacetates as the stereoisomeric derivatives of this carbon atom. The two pentacetates (also the tetracetate chloride of Colley and the pentabenzoate of Skraup) have no properties of aldehyde, neither of alcohol. They cannot be compared with oxides, such as ethylenic-oxide, nor with the lactones (olides). They differ in melting-point, solubility, and optical activity. Both are dextro-rotatory, but the power of rotation of the one is very small, that of the other very great. In association with Mr. Lobry de Bruyn he could not find any difference in the chemical behaviour, so that no reason exists to admit that they are structural isomeric. With ammonia they seem to produce acetamide and the same product that is given by glucose itself, isomeric with glucosamine and isoglucosamine. The pentacetate with the higher melting-point can be transformed in that with the lower by heating with zinc-chloride, the presence of a solvent as xylene being favourable but not necessary. The above considerations on the tautomeric form of glucose can be applied on other aldols (olals) and throw new light on their peculiar behaviour in some circumstances.

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