THURSDAY, MARCH 30, 1893.

ELECTROMAGNETIC WAVES.

Electrical Papers. Two vols. By Oliver Heaviside. (London: Macmillan and Co., 1892.)

IN these two volumes the author has collected the papers on electrical subjects which he has rom time to time contributed to the *Philosophical Magazine*, the *Philosophical Transactions*, the *Electrician*, and other technical journals. The result is a work of some eleven hundred closely printed octavo pages; that is to say, on a rough estimate, it contains in printed matter about half as much again as Maxwell's two volumes on Electricity and Magnetism, and considerably more than the two volumes of Thomson and Tait. When we add that the author brings into action freely (though with perfect mastery) some of the most elaborate weapons of mathematical physics, and that considerable passages are moreover written in a special condensed notation, it will be evident that the task of the reviewer is no easy one. All that we shall here attempt is to give a general idea of the nature of the book, with some reference to its more original features.

The first few articles are devoted to practical questions, such as duplex telegraphy, signalling with condensers, the best arrangement of Wheatstone's bridge, and so on. These are thoroughly readable, and, apart from their technical value, may be commended to mathematical students as containing interesting concrete applications of electrical theory. The rest of the book is partly a commentary on, and partly a development of, the latter part of Maxwell's treatise, and deals mainly with the propagation of electromagnetic effects in space and time. It is therefore closely connected with the theoretical work of Poynting and J. J. Thomson on the one hand, and with the practical investigations of Hertz and his followers on the other. At the present time there is no great difficulty in following in imagination the propagation of inductive effects from one conductor to another across the intervening space; and that this should be the case is due in no small degree to the labours of our author, for although probably few readers have been found to follow him step by step, yet many have admired the tenacity with which he attacks problem after problem bearing on his subject, and have gathered valuable ideas and suggestions from his exuberant pages.

One of the most noteworthy features in the author's theoretical work is the elimination of the "vector-potential" from Maxwell's equations of the electromagnetic field, with the result that the equations in question are obtained in a "duplex form" in which there is perfect symmetry as regards the parts played by the electric and the magnetic variables respectively, so that the equations are unaltered in form when a reciprocal substitution between the two sets of variables is made. The same simplification has been made independently by Hertz. It is of importance for this reason, that the vector-potential is to a certain extent indeterminate. This was indeed insisted upon by Maxwell himself, but, strange to say, he did not always remember his own warning, with the result that more than one most important passage of his great work is rendered needlessly obscure. Another function which the author seeks (we think rightly) to relegate to the position of a mere mathematical implement, without physical significance beyond the domain of electrostatics, is the electric potential. There is nothing paradoxical in this, for the original definition of this function postulates a state of equilibrium.

The last paper (but one) in the book forms a sort of crown to the whole. It is entitled "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," and is reprinted from the *Philosophical Transactions* for 1892 (A). Unfortunately this paper is by far the hardest to read. Free use is made of the scalar and vector products of Hamilton, but the author is careful to give us his emphatic opinion that quaternions proper are unsuited to the purposes of mathematical physics. This courageous declaration will, we fear, cause a wicked joy in the hearts of many who have struggled in vain with these refractory symbols. For the special system of mathematical shorthand affected by Mr. Heaviside there is much to be said, but for our own part we should prefer to have papers which profess to give new and important results written in the more homely language of "Mr. Cartesian." Another prominent feature in this memoir is the frequent appeal to the principle of "continuity of energy," but this imposing phrase seems to mean nothing more nor less than Maxwell's negation of action at a distance. The author, indeed, takes care to explain that he does not countenance the notion of "identity of energy" which one prominent physicist has attempted to base on a well-known paper by Poynting. It is now generally recognised that the flux of energy in the electromagnetic field is indeterminate. In his treatment of induction in moving media, a very important but most difficult subject, the author is led to at least one definite conclusion of great interest, viz. the existence of a magnetic force acting on a body moved across the lines of electric induction, just as there is an electric force on a body moved across the lines of magnetic induction. This is in conformity with the duplex character of the fundamental equations already referred to. Finally, we must not omit to notice a somewhat startling proposal for a radical change in the system of electric and magnetic units. In the "rational" system advocated by our author, *one* line of force would emanate from a unit magnetic pole, instead of 4π such lines, so that the force between two poles m,m' at a distance r apart would be $mm'/4\pi r^2$ instead of mm'/r^2 as at present. The existing system is denounced as containing an absurdity of the same nature as if we were to define the unit area to be the area of a circle of unit diameter.

It remains to say a word or two about the style in which the book is written. It is exceedingly fluent, often discursive, and occasionally boisterous, as when the author, introducing the functions called zonal harmonics, remarks that "these are Murphy's P's; *not praties*, but the functions invented by Murphy"; or again, when in his impatience of vector and other potential functions he gives utterance to the wish to "*murder the whole lot.*" A more serious matter is that the papers in these volumes often overlap, whilst the frequent cross-

references make it difficult to detach any one from the rest, or to gather the substance of the author's speculations on any one part of his subject. In the preface he tells us that he had been urged to publish not a reprint, but a systematic treatise. It is, we think, greatly to be regretted that he has not found it possible to take this advice. The labour of compression and of proper co-ordination would no doubt have been great, but it would have been amply repaid by the increased currency given to the author's views. As it is, we fear that the fate of these weighty volumes will be that students of the stamp which Mr. Heaviside would most wish to attract will turn over his pages, picking up a suggestion here and there, will then work out things in their own way, and finally return to the present treatise to ascertain how far their results have been anticipated. And this is really matter for regret, for almost every page bears the impress of a vigorous and original mind, and we cannot doubt that the author's speculations would have exercised a considerable influence on the progress of electromagnetic theory, if it had not been for the disadvantageous form under which they are presented. H. L.

THE GREAT SEA-SERPENT.

The Great Sea-Serpent. An Historical and Critical Treatise. With Reports of 187 Appearances (including those of the Appendix), the Suppositions and Suggestions of Scientific and Non-scientific Persons, and the Author's Conclusions. With 82 illustrations. By A. C. Oudemans, Jzn. Published by the Author, October, 1892. (London : Luzac and Co.)

IN a large, well-printed volume, Dr. A. C. Oudemans, Jzn., publishes what he is pleased to call "an historical and critical treatise" about the "Great Sea-Serpent," with the reports of 187 appearances, the suppositions and suggestions of scientific and non-scientific persons, and the author's conclusions.

It is impossible, however, to treat this laborious work as a scientific treatise, nor will the author, we trust, be vexed with us when we add that it is the very last form of a work that we would have expected from the pen of the learned Director of the Zoological Gardens at the Hague. for when one gets by practise to know the utter worthlessness of the descriptions given by even well-educated persons of often the most easily diagnosed forms of life—and surely experience of this nature must often have come across Dr. Oudemans's path—one cannot fail to regard as positively hopeless the reconciling of a mass of such crude observations as fill the pages of this book. The very trouble and no doubt anxiety caused by reading over such a pitiful series of records has to some extent affected the author, for he quotes as the motto for his volume the extremely sensible words of a very able biologist, whose chief fault it was not to leave a greater record of his wisdom for posterity, to the effect "That it is always unsafe to deny positively any phenomena that may be wholly or in part inexplicable," meaning thereby to deny a phenomenon because it cannot be explained, and then in the immediately following preface he compares himself to Chladni, who took the trouble to collect all the accounts concerning observations of "meteoric stones," and showed the immense number of *facts* that he had found out about them. In this one word fact—*fact*—lies a great world of difference between Chladni's meteoric stones and Oudemans's sea-serpents. The meteoric stones could be seen and handled, the sea-serpents "are very shy, and it is not advisable to approach them with a steamboat." "Instantaneous photographs of the animal will alone convince zoologists, while all their reports and pencil drawings will be received with a shrug of the shoulders"; this latter sentence, which precedes the preface, makes one shudder at the amount of "reports and pencil drawings" contained in the six hundred following pages.

And yet, perhaps, this work is not altogether without its value. From the middle of the sixteenth century—when Olaus Magnus wrote about "a very large serpent of a length of upwards of 200 feet and twenty feet in diameter, which lived in rocks and holes near the shore of Bergin"—until this very present hour all sorts and manners of gigantic forms have been reported about by sailors and others, and even pencil drawings of them have been made, and the collecting together and printing of such a series of records forms as strange a chapter of the science known by the people as has ever made its appearance.

There is but little necessity of insisting on the need of experience in seeing ere one can describe what is seen, nor on the need of a power of describing what one correctly sees so that the description may be applicable, nor need one wonder that such powers of seeing and describing were not to be found united in the many seagoing worthies whose extraordinary narratives crowd the pages of this volume. But what are we to say about the capacity for belief to be found in the compiler of this work, who concludes his task by naming a form he has never seen, *Megophias megophias* (Raf.) Oud., and further thinks that a Phylogenetic table, which he gives, "will in a practical manner show the rank which, in my opinion, sea-serpents occupy in the system of nature"?

This volume contains an account of the "literature" on the subject of sea-serpents; a detailed record of the various accounts and reports concerning observations of sea-serpents chronologically arranged and thoroughly discussed; and criticisms on the papers written on the same subject; next the various explanations hitherto given, and lastly the author's own conclusions—these he divides into "fables, fictions, exaggerations and errors," and what he is pleased to call "facts." Among the fictions he regards the belief that the sea-serpent "casts its skin, as common snakes do, and that it is born on land"; among the exaggerations that it has "a tail fully a hundred and fifty feet in length"! among the errors "that there are *two* species of sea-serpents, or that there are several species of them all belonging to the same genus"; or that "it ever takes [mistakes] a boat for one of the other sex."

As to the *facts*, which may be—it is well to note—"*inferred from what is reported*," we find enumerated among them the external characters of the sea-serpent, its dimensions, form, and skin. Of its internal characters "it is not astonishing that we don't know much," yet it is clear "that if the animal opens its mouth there

is an opportunity to learn something about its teeth, tongue, &c.," and so we get a series of "inferred" facts about them. We have further details of its colours, sexual differences, a very full account of its "physiological characters," some of its "psychical characters," concluding with its enemies, its repose, its sleep, and its death.

Enough has been written to prove that this volume is not without a certain amount of interest. We have found it a rather troublesome task to read it through, but to open its pages at random one is sure to be arrested by some startling phase of belief or by some marvellous narration, and the first half of the book very certainly deserves to be described as a conscientious compilation. It is written in most excellent English.

PUBLIC HEALTH.

A Treatise on Public Health and its Applications in Different European Countries. By Albert Palmberg, M.D., Medical Officer of Health for the County of Helsingfors in Finland. Translated from the French edition, and the section on England edited by Arthur Newsholme, M.D. (Lond.), D.P.H., Medical Officer of Health for Brighton. (London: Swan Sonnenschein and Co., 1893.)

ALTHOUGH scarcely more than a year has elapsed since the issue of the Swedish edition of this work, translations of it have already appeared in French, English, and Spanish. A book which within so short an interval has attained to such a pitch of popularity may be admitted to have practically established its claim to rank amongst the important contributions towards the literature of the subject with which it is concerned. Extensive indeed as is the ground travelled over by the author, yet so ably has the material been handled, that we feel it to be a matter for regret that the writer was unable to deal with the hygienic administration of all, instead of a portion only, of the important European countries. The sanitary administrations of England, Scotland, France, Germany, Austria, Sweden, and Finland are detailed; but the description of the Public Health service of Russia, Denmark, Norway, Holland, and Italy is omitted. Not having visited these countries, and studied the subject by a personal inquiry on the spot, Dr. Palmberg very wisely preferred not to deal with them at all, rather than run the risk of making inexact statements concerning them

In treating of the various countries, the plan which the writer has followed has been first to give a brief summary of the sanitary laws in force, and then to describe in detail the methods adopted in the capital towns for carrying out these regulations. Of all countries England claims the largest share of attention, Dr. Palmberg assigning to her the chief place amongst the nations for the excellence of her Public Health administration, and the care with which all matters connected with hygiene are attended to. The chapter on England contains a good *résumé* of our principal sanitary laws, together with a summary of the model bye-laws of the Local Government Board. The description of sanitary apparatus is excellent, the text being plentifully supplied with illustrations. Notwithstanding the limited space which is allotted to each country, the author is nevertheless able to introduce a mass of detail relating to practical sanitation which we believe would be looked for in vain even in our standard text-books on hygiene. We may instance as examples of this the paragraphs on the scavenging of London, and the disposal of rubbish and street refuse; the description of the preventive measures adopted in this country for the limitation of the spread of infectious disease, together with an account of the ambulance service and hospital ships; the explanation of the methods adopted for the ventilation of some of our important public buildings; the excellent *résumé* of school hygiene, for which we have no doubt the author is deeply indebted to Dr. Newsholme; and the summary on industrial hygiene, although the author is rather inclined to repeat many of his remarks under this head when describing "the sanitary provisions as to industries." Dr. Palmberg's admiration of English sanitation is pronounced, and in commenting on our appreciation of the beneficent results of good ventilation, we find him giving vent to the quaint statement that "even in cold weather the windows of high houses are opened, children and adults without fear of chill breathing the pure air"!

France, the author informs us, has no general sanitary law, most of the sanitary regulations in force consisting of ministerial decrees, orders of prefects and councils of health. Corresponding to this laxity of sanitary control, the great sanitary improvements which have been from time to time introduced have not been followed in Paris by a continuous fall in mortality, as in the case of the other European capitals. As the author very rightly remarks, the time is past when it can be supposed that good sense and administrative capacity merely suffice for the regulation of the Public Health. The drainage of Paris is exhaustively treated, the sewerage of the town being dealt with in detail, the writer in the course of his description pointing out that the system in use is objectionable, inasmuch as it allows deposits of sand to occur, and necessitates the maintenance of an army of 850 men to keep the sewers clear, the workers themselves at the same time having a relative mortality from typhoid fever twice as great as that for all Paris. Moreover, owing to the friction of the enormous deposits of sand in the sewers the wear and tear on the latter are great, and compel frequent repairs.

The sanitation of Germany and Austria is dealt with in the same thorough spirit as pervades the rest of the book and calls for no special remark.

In the description of the general regulations in force in Sweden relating to hygiene in towns, we think, however, that these laws might with advantage have been more systematised, much after the plan that the writer has adopted in dealing with Finland.

The translation is remarkably well done, and with one exception is quite free from the sort of mistake usually met with in English editions of foreign works. The instance we refer to occurs on page 380, where the author, in describing the forms of stove ordinarily employed in Germany, makes use of the following words:—"Although the construction differs from that of the English ventilating stoves *made by Douglas Galton* and Boyle and Son."

Dr. Palmberg's book is undoubtedly a valuable one, and should prove of the utmost utility to all interested in

sanitary science. By placing in our hands a description of the Public Health systems in vogue amongst continental nations, it allows us the opportunity of comparing them with our own, and correcting our shortcomings by their experiences. Notably should this be the case in our methods of food inspection. H. BROCK.

OUR BOOK SHELF.

The English Flower Garden: Style, Position, and Arrangement; followed by a Description of all the best Plants for it, their Culture and Arrangement. By W. Robinson. Third Edition. (London: John Murray, 1893.)

THIS quite recently published new edition of this most charming and useful book has been so completely altered as to be at first sight scarcely recognisable, and we are glad to record that all these alterations have been improvements, the result of a determination on the author's part never to give up the effort of making it better. In the present edition the old plates, many of which contained but feeble portraits of plant life, have been broken up, and in their places we find delightful pictures of some of our best loved flowering shrubs and plants, at one time represented as growing over walls or cottage porch, or again by the lake or riverside. All of these are perhaps not equal in execution, but it has seldom happened to us to see so large a number of illustrations with so few that are below a high standard. Such delightful woodcuts as those of the double flowering hollyhock, the Alpine pink, or of *Rodgersia podophylla* brighten up the pages and add much of interest to this book. So familiar is this volume to most lovers of plants, of which the fact of three editions within ten years is a satisfactory proof, that it seems almost needless to explain that the first portion of it is devoted to a series of chapters on such subjects as design and position of a garden, on the wild garden, the Alpine garden, on spring, summer, and autumn flowers, and we note even on "Pergolas," the illustration of this latter being from Venice. Alas! in these northern countries our sunshine scarcely ever needs a shade. The whole of the first portion of the book is rewritten, and many new illustrations are given, such as the "primrose garden in a small clearing of a birch wood" in Surrey, the group of "Solomon's seal at the foot of a wall," and others too numerous to mention.

The second and much larger portion is devoted to a list, arranged in alphabetical order, of all those plants that have been grown successfully in the gardens of Great Britain and Ireland, and of some few that may be expected to grow there. Like the rest of the volume, this part too has been very thoroughly revised and brought up to date. To every one in the possession of a garden, or having the care of one, we would say study this "English Flower Garden," for you cannot do so without profit.

Logarithmic Tables. By Prof. George William Jones. (London: Macmillan and Co., 1893.)

THIS book of tables, which we notice has reached its fourth edition, will be found to serve the purpose for many computations which require an accuracy extending only to four or five places of decimals. The tables throughout seem to be well arranged, and the figures neatly printed, thus fulfilling two important requirements from the computer's standpoint. In addition to five-place logarithms there is a table to four-places, together with four-place trigonometric functions, a table of useful constants, and an addition-subtraction table. Among others we may mention a five-place table of natural sines, &c., with a six-place table of their logarithms, prime and composite numbers, squares, cubes, square roots, &c., Bessel's coefficients for interpolation to the fifth differences, binomial coefficients for interpolation, also for fifth differences, and lastly a useful table of the errors of observations, from which we can at a glance determine the ordinates of the probability curve, values of probability integrals, &c. An explanation, preceding the tables themselves, shows how they may be advantageously used, and the author offers the reward of "a dollar" for the first notice of a mistake "to promote the detection of errors."

Catalogue of the British Echinoderms in the British Museum (Natural History). By F. Jeffrey Bell, M.A. (London: Printed by Order of the Trustees.)

DURING recent years many additions have been made to the collection of echinoderms in the British Museum; and, as Dr. Günther explains in his preface to the present volume, much time and labour have been given to the study and arrangement of these additions. It seemed expedient, he says, to prepare, together with the nominal list of the specimens, a complete account of the species hitherto found in British seas. All students of the subject will congratulate themselves on the fact that this decision was arrived at, for the result is that they are now provided with a handbook which will enable them to identify, without much difficulty, any specimens that may come in their way. Mr. Bell, in beginning the preparation of so full a catalogue, had before him a task of no small difficulty, and in the manner in which he has discharged it he has displayed great patience, insight, and knowledge. A number of well-printed plates add largely to the value of the work.

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 Hatching of a Peripatus Egg.

IN NATURE, vol. xliv. p. 468, I briefly described some eggs of the larger Victorian *Peripatus*, which were laid by specimens kept alive by me in the winter (Australian) of 1891. At that time, following previous authority, I identified the species which laid the eggs as *P. leuckartii*. It appears now, however, that the real *P. leuckartii*—at any rate, in New South Wales—is undoubtedly viviparous, and our oviparous Victorian species is, therefore, probably distinct. (It may be remembered that in NATURE, vol. xxxix. p. 366, I suggested this probable distinction on account of the remarkable pattern of the skin usually exhibited by the fifteen-legged Victorian form.) Further particulars on this subject are given in my "Further Notes on the oviparity of the larger Victorian Peripatus, generally known as *P. leuckartii*,"[1] and in the literature cited therein. In that paper I described two embryos, removed from eggs which had been laid for about three and eight months respectively. In the latter case I showed that the embryo was possessed of the full number of appendages, and was in all respects a perfect young *Peripatus*, differing externally from the adult only in the smaller size and less deeply pigmented skin. On the strength of these observations I claimed to have definitely proved that the larger Victorian *Peripatus* at any rate sometimes lays eggs, and that these eggs are capable of undergoing development outside the body until perfect young animals are produced. I am now able to add some further information.

For some time only one egg (belonging to the original lot, for none have since been obtained) remained in the hatching box. The shell of this egg had changed to a dark brownish colour, and latterly an embryo had been visible through the shell, coiled up inside. The egg was lying on a small piece of rotten wood, which rested on the glass floor of the hatching box. On

[1] "Proceedings of the Royal Society of Victoria," vol. v. p. 27; also *Annals and Magazine of Natural History*, 1892.

January 3, 1893, not having opened the box for some days, I made an examination. The egg was in its former position, so far as I could tell, but the shell was split on one side and the young *Peripatus* had escaped. This young *Peripatus* was found lying dead on the glass floor of the hatching box, 25 mm. distant from the shell. It must have crawled off the rotten wood and along the glass to the position in which it was found. It was only about 5 mm. in length, so that, even assuming that it moved in a perfectly straight line, it must have crawled for a distance five times its own length. To the naked eye the young animal appeared of a pale greenish colour. It could not have been dead for very many days, but decomposition had already set in, and the animal was stuck to the glass on which it lay. It was impossible to remove it without considerable injury, but I ultimately succeeded in mounting it in Canada balsam, and it is impossible, even in its present condition, to doubt that it really is a young *Peripatus*, for the characteristic jaws and claws are well shown. I also mounted the ruptured egg-shell, and found that the characteristic sculpturing on the outside was still clearly visible.

This egg, then, hatched out after being laid for about seventeen months (from about July 1891 to about the end of December 1892). I cannot believe that under natural conditions the embryos take so long to develop. At any rate it now appears certain that the larger Victorian *Peripatus* lays eggs which may hatch after a lapse of a year and five months.

ARTHUR DENDY.

The University of Melbourne, February.

A Simple Rule for finding the Day of the Week corresponding to any given Day of the Month and Year.

A RULE was lately mentioned to me by a friend for finding, almost by inspection, the day of the week for any given year and day of any month in that year, during the present century. The basis of the rule is so obvious, when once the rule is stated, as to require no demonstration, but it struck me as so ingenious as to be worth while communicating it to you in case you deemed it worthy of insertion. I also append a very easy method of extending the rule to any date subsequent to the introduction of the Julian intercalation either in the past or future, except indeed for the eighteenth century, in which the introduction of the new style requires a special treatment.

The nineteenth century rule above alluded to is this. Each of the 12 months has its special numerical constant, thus:—

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5	6	6	2	5	0	2	3	1	3	6	1

Write down four columns thus

A | B | C | D

Under A enter day of month, under B constant for that month, under C year of century, under D greatest multiple of 4 in the year of century.

Add together the numbers under these heads, divide by 7, and the remainder is day of week; except that in Leap Year 1 must be subtracted for any day before February 29.

Example.—June 18, 1815 (Battle of Waterloo):—

A	B	C	D	Sum.		Remr.	
18	0	15	3	36	$\frac{36}{7}$	1	Sunday.

February 1, 1892:—

A	B	C	D	Sum.		Remr.	
1	6	92	23	122	$\frac{122}{7}$	3	Sunday

Subtract 1 for Leap Year before February 29. *Ans.*—3 − 1 = 2 or Monday.

December 25, 1892:—

A	B	C	D	Sum.		Remr.	
25	1	92	23	141	$\frac{141}{7}$	1	Sunday.

To extend the rule to any future century, we have only to alter the monthly constants, adding 5 to each for each added century after the present, and 1 for each century, an exact multiple of 4, in the interval.

Thus for the thirty-first century. Number of added centuries is 12, and there are 3 centuries, succeeding multiples of 4 (twenty-first, twenty-fifth, and twenty-ninth). Therefore add 5 × 12 + 3 = 63, or omitting multiples of 7, add 0.

Hence, constants for thirty-first century are the same for the present century.

New Year's Day, 3001,

A	B	C	D	Sum.	Remr.	
1	3	1	0	5	5	Thursday.

For centuries anterior to the eighteenth we must first of all find by special method what the monthly constants would have been throughout the eighteenth century without the change of style, and then subtract 6 for each century short of the eighteenth.

It may easily be seen that the constants throughout the eighteenth century would have been without change of style.

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2	5	5	1	3	6	1	4	0	2	5	0

For the eleventh century subtract 7 × 6 or 42, *i.e.* since this is multiple of 7 subtract 0, and we get the same repeated.

For the seventeenth subtract 6, and remember that when the result is negative we must replace it by the defect of the corresponding positive number from 7, and we get

3	6	6	2	4	0	2	5	1	2	5	1

Example.—Battle of Hastings, Oct. 14, 1066.

A	B	C	D	Sum.	Remr.	
14	2	66	16	98	0	Saturday.

Execution of Charles I., Jan. 30, 1649,

A	B	C	D		Sum.		Remr.	
30	3	49	12	=	94	$\frac{94}{7}$	3	Tuesday.

H. W. W.

"Roche's Limit."

WITH reference to Prof. G. H. Darwin's notes (NATURE, March 16, p. 460) on the investigations of M. Roche as to the smallest distance from its primary at which a satellite can exist, does not the distance given—viz. 2·44 times the radius of the primary—refer to the case of the satellite having the same density as its primary? In Note 3 Prof. Darwin warns the reader that Roche's limit depends, to some extent, on the density of the planet. Suppose the density of the planet to remain the same while that of the satellite is taken at double. In this case the tidal or differential influence of the planet on the two halves of the satellite will have doubled, while the gravitational attraction of the two halves of the satellite on each other will have become fourfold; and generally, the power of the planet to pull the satellite asunder will be inversely as the density of the satellite, and directly as the density of the planet.

An alteration of the size of the satellite does not much affect the question, because both forces are thereby equally altered, so long as the satellite is very small in comparison with its distance from the planet.

Seeing that the tidal or differential influence of a planet on its satellite is inversely as the cube of their distance apart, perhaps it would be correct—as far as gravitational influence alone is concerned—to state the limit at which a satellite can exist as being equal to $2{\cdot}44\ R \times \left(\frac{D}{d}\right)^{\frac{1}{3}}$

where R = the radius of the planet,
D = the density of the planet,
d = the density of the satellite.

As an interesting case of the same problem from a different point of view, suppose two very small equal spheres in contact, and a third much larger sphere placed in line with their centres, all three having the same density; then, when the distance of the point of contact of the small spheres from the centre of the large one is 2·52 times the radius of the large one, the attraction of the two small spheres for each other just balances the differential influence of the large one tending to draw them asunder. The effects of variation in density and size being the same in this case as in the former.

It would probably be interesting to many of your readers to have Prof. Darwin's views as to whether it is a reasonable supposition that a small satellite, such as Jupiter's fifth, is likely to have the same density as Jupiter; and whether the meteorites forming Saturn's ring are likely to be of so small density as

Saturn; as it would appear that without making some such supposition, no definite limit can be fixed.

Applying this supposition to the sun, with reference to meteoric swarms, we have 2·44 times the sun's radius, taken at 433,000 miles, or 1,056,520 miles as the distance at which the sun would prevent the meteors coalescing to form a planet. In Note 3 Prof. Darwin states this at one-tenth of the earth's distance from the sun, probably by inadvertence. G. R.

The Ordnance Survey and Geological Faults.

IN view of the re-survey of the United Kingdom, it seems to me that if the officers of the Survey were directed to take special notice of the levels of the former survey on both sides of great geological faults, and to compare these levels now so as to ascertain if any appreciable relative change had taken place during the forty or fifty years since the first survey, valuable information as to the motion of these faults, if any, might be obtained.

This idea is mainly suggested to me by the fact that in this neighbourhood a great fault intersects the Old Red Sandstone close to its contact with the Highland schists, it has been traced from Stonehaven on the east coast to Loch Lomond on the west, and seems to give remarkable evidence of being, at least to a certain extent, in motion. The village of Comrie, famous for its "earthquakes," is situated on this fault, and the "earthquakes" are as lively as ever. In the valley of Strathmore farmhouses placed in the proximity of this great dislocation are, or were, celebrated for being "haunted," on account of the noises and tremors by which the inhabitants are from time to time alarmed.

Most, if not all, British "earthquakes" have been, I think, wisely attributed to similar causes.

Of course fifty years is a very minute part of the history of one of these old faults, but if the data of the Ordnance Survey be so accurate as is usually supposed, some trace of shifting might possibly be discovered if the necessary observations were made.

Newport, Fife, March 18. JAS. DURHAM.

The Discovery of the Potential.

MR. E. J. ROUTH has lately published a most valuable "Treatise on Analytical Statics." I quote from the second volume, p. 17, the following note:—

"The earliest use of the function now called the potential, is due to Legendre in 1784, who refers to it when discussing the attraction of a solid of revolution. Legendre, however, expressly ascribes the introduction of the function to Laplace, and quotes from him the theorem connecting the components of attraction with the differential coefficients of the function. The name, Potential, was first used by Green," etc.

From this note it appears that the discovery of the potential must be attributed to Laplace. This is a wrong opinion, and some fifteen years ago Baltzer proved that the introduction of the function is due to Lagrange ("Zur Geschichte des Potentials," in *Journal für die reine und angewandte Mathematik*, vol. lxxxvi. p. 213, 1878). Some historical documents in favour of Lagrange's priority have been found, by the writer of these lines, in Todhunter's "History of the Mathematical Theories of Attraction and the Figure of the Earth," and collected in a note at the end of vol. i. of his work, "Il Problema Meccanico della Figura della Terra" (Torino, 1880), where a full account of the early history of the potential is given, with numerous bibliographical indications. OTTAVIO ZANOTTI BIANCO.

Private Docent in the University of Turin,
March 21.

THE historical note on p. 17 of my "Statics" is chiefly founded on the statements in Todhunter's "History," and in Thomson and Tait's "Natural Philosophy." The references to these two writers are given in the note. Both Dr. Todhunter and Lord Kelvin ascribe the introduction of the function for gravitation to Laplace, and assert that the name of "Potential" was first given to it by Green. My own reading, though not so extensive as theirs, had not led me to form any different opinion. In Nichol's "Cyclopædia of the Physical Sciences" the first introduction is given as due chiefly to Legendre, Lagrange, Laplace, and Poisson. In Chambers's "Cyclopædia" Laplace's name alone is mentioned. Baltzer, as cited by Mr. Bianco, mentions the use of the function by Lagrange in the *Mém. de Berlin*, 1777. This is earlier than the memoir of Legendre, but as Legendre assigns the introduction of the function to Laplace, it is difficult to compare the dates. I am at present unable to refer either to the memoir of Lagrange or to the treatise of Mr. Bianco.

E. J. ROUTH.

Van't Hoff's "Stereochemistry."

THE review of the above by "F. R. J." in NATURE, p. 436, raises some important points in connection with this peculiarly fascinating branch of chemical science. In referring to the recent ingenious and attractive theory of P. A. Guye, that the numerical value of optical activity is dependent upon the relative masses of the four groups attached to the asymmetric carbon atom, and which carries with it the corollary that if two of these four groups are of equal mass the rotatory power will cease, your reviewer states that Guye "was unable to verify this view in all strictness." I think, however, that he hardly emphasises sufficiently that this important corollary has in every case, when put to the test of direct experiment, broken down. As far as I am aware, there is not a single instance of an asymmetric carbon atom attached to four groups *qualitatively distinct*, being found optically inactive in consequence of two of those groups being *quantitatively equal in mass*. Indeed some such substances are not merely active but powerfully so. The reviewer considers that this inadequacy of Guye's theory is palliated by the alleged fact that the amount of rotatory power of the esters of an active acid is determined by the weight of the alkyl-group. This point, which is one of the cardinal pillars of Guye's theory, I have recently put to the test of actual experiment, by measuring the rotatory power of a number of the esters of active glyceric acid, which have been prepared by Mr. J. MacGregor and myself. In this investigation we found the most extraordinary verification of Guye's theory, as far as the optical properties of the normal series of methyl, ethyl, and propyl glycerates were concerned; with the appearance of isomerism, however, this regularity ceases, thus the isopropyl glycerate has a markedly lower rotation than the normal one, whilst the normal and secondary butyl compounds have a lower rotation than the isobutyl ester. Nor are these differences consistently explicable by taking into consideration the interatomic distances, as measured by atomic volume, for the molecular volume of the normal propyl glycerate with its greater rotation is less than that of the isopropyl compound with its smaller rotation, whilst the molecular volumes of the isobutyl and secondary butyl glycerates are almost exactly equal, although the rotation of the former is much greater than that of the latter.

The reviewer, in referring to the rotation exhibited by the salts of active acids, states that in the case of tartaric acid all the salts "display in solution the same rotatory power, irrespective of the atomic weight of the metal," and is apparently satisfied that "the clue to this anomaly is furnished by the electrolytic theory of Arrhenius," according to which "it is the ion $CO_2(CHOH)_2CO_2$ which is alone responsible for the rotation." The reviewer has in this endorsed the method of special pleading adopted by the advocates of this theory, in which the metallic tartrates have been summoned as witnesses, whilst only the testimony of those favourable to the theory has been admitted. Thus one of the commonest of the metallic salts of tartaric acid—tartar emetic—has a rotation which differs entirely from that of the other tartrates, and thus conclusively negatives the dogma that the rotation of the solutions of metallic salts is independent of the particular metal which has replaced the hydrogen of the acid. Fresh light has been thrown on this point in the course of an investigation, which I have recently carried out with Mr. Appleyard on the rotatory power of the metallic salts of active glyceric acid, and which has shown that the specific rotatory power of the glyceric acid has one value when deduced from the rotations of its alkaline salts (lithium, ammonium, sodium, and potassium), another value when deduced from the salts of the alkaline earths (calcium, strontium, and barium), and a third from the salts of the magnesium group of metals (magnesium, zinc, and cadmium). Now it so happens that almost the only salts of tartaric acid which have had their rotation determined are those of the alkaline metals, which also in the case of glyceric acid yield practically the same rotation. Hence if only the rotations of the alkaline glycerates had been determined, the same erroneous conclusion would have been arrived at concerning the rotation of glyceric acid. Whatever may be the ultimate interpretation put upon these new results, and I prefer for the present to ab-

stain from any generalisations, it is obvious that the notion of the rotatory power of saline solutions being independent of the particular metal present in the salt is altogether untenable.

PERCY F. FRANKLAND.

University College, Dundee, March 11.

THE notice referred to by Prof. Percy F. Frankland was written, and the proof returned to the printer, before the end of last year. Since then two researches have been published—by Purdie and Walker, and by Frankland and Appleyard—in which facts are adduced, apparently irreconcilable with Guye's theory. Had these facts been at my disposal I should doubtless have expressed myself more guardedly.

Prof. Frankland says: "As far as I am aware, there is not a single instance of an asymmetric carbon atom attached to four groups *qualitatively distinct*, being found optically inactive in consequence of two of those groups being *quantitatively equal in mass*;" and he complains that I have hardly emphasised this sufficiently. My reason was, that I was not altogether convinced of the fact, as may be seen from the following passage, which I transcribe, and which originally formed a footnote to the notice in question:—

"The present reviewer ventures to suggest that cases such as are sought by Guye are to be found in those compounds in which two of the four different groups attached to an asymmetric carbon atom are themselves asymmetric carbon atoms of equal and opposite enantiomorphism. Such compounds would exist in two distinct forms; but as the two opposite enantiomorphic groups would be of equal mass and would be situated at equal distances from the central asymmetric carbon atom to which they are attached (inasmuch as the two opposite enantiomorphic modifications of a compound always have the same molecular volume), the conditions necessary for optical inactivity according to Guye's theory would be fulfilled, and neither of the two forms ought to cause rotation of the polarised ray. Such a case has already been observed in the two inactive, non-racemic trihydroxyglutaric acids described by Emil Fischer (*Ber. der deutsch. chem. Ges.* 24, p. 4214), although it does not appear to have been hitherto interpreted from this point of view."

I afterwards suppressed this footnote, partly because it seemed to me out of place in such a notice, and partly because the optical activity of the two trihydroxyglutaric acids could be accounted for in another way: namely, by the fact that, as pointed out by E. Fischer, the mirror images of their molecules are congruent with the molecules themselves. But the passage will show why I was indisposed to enter a proved negative against Guye's theory.

As regards the charge of "endorsing special pleading" in the interests of the electrolytic theory of Arrhenius by suppressing the fact that tartar emetic has, in solution, a different rotation from the other metallic tartrates, I may say at once that I was ignorant of this fact. I am not a specialist on the subject of the optical properties of organic compounds, and I merely summarised, doubtless uncritically, the account of Oudemans' law given in van't Hoff's book. Indeed, the brief notice, as its wording everywhere indicated, was a summary rather than a criticism.

I take this opportunity of rectifying an omission. At the time of writing the notice I was not aware that Prof. Crum Brown had, independently of M. Guye, put forward, in the Proceedings of the Royal Society of Edinburgh, views on the influence of the various substituting radicles in modifying the optical rotation of organic compounds. F. R. JAPP.

University of Aberdeen, March 18.

Standard Barometry.

THE question of absolute accuracy in barometer readings is one of great importance to meteorologists; but there has been so much uncertainty shown by the accumulated facts relating to the subject, that I think that no one who has carefully studied the matter has felt fully satisfied that strictly comparable international standards had been obtained. An uncertainty of at least 0·1 mm. was indicated by the various international comparisons of normal barometers which have been carefully made and discussed during the past ten years. I think that at last a definite conclusion has been reached, and that the very recent results published in paper No. 4, Band xvi. of the *Repertorium für Meteorologie* will be accepted as proving that at St. Petersburg at least normal readings are obtained.

About twenty-five years ago Director Wild, of the Central Physical Observatory at St. Petersburg, established the first normal barometer of the *modern* form; and as much as twenty years ago he claimed to have obtained practically normal readings. Moreover, he urged that the transfer of these normal readings from place to place by means of portable barometers was impossible within the desired limits of accuracy, and that each country ought to have its own thoroughly investigated normal barometer. This last has been proved by the results obtained by various investigators; and now Prof. Wild offers the proof of the accuracy of his normal barometer in the paper just referred to, which bears the title "Die normal-barometer des Physikalischen Central-Observatoriums zu St. Petersburg."

This paper was presented to the Academy of Sciences on November 4, 1892, and in it Wild gives the results of the inter-comparison of three local normal barometers.

Normal barometer No. I. was mounted at St. Petersburg in 1870, and was fully described in Band iii. of the *Repert. f. Meteor.*

A second normal barometer was mounted at Pawlowsk (about twenty miles from St. Petersburg) in 1887, and a third normal was mounted at St. Petersburg in 1891, and is known as normal No. II.

In 1887 and 1888 Wild found that the St. Petersburg normal I. and the Pawlowsk normal did not differ by more than 0·01 mm.

In 1892 the St. Petersburg normals I. and II. were found to agree within the limit of error of observation (less than 0·01 mm.).

In 1892 the St. Petersburg Normal II. was dismounted, taken to Pawlowsk, and there compared with the Pawlowsk normal, and the two were found to differ by only 0·01 or 0·02 mm.; that is ·004 or ·008 inch. It must be added that these comparisons have all been checked by means of comparisons with portable barometers of the highest class.

The paper by Prof. Wild is accompanied by illustrations of these various normal barometers. The St. Petersburg normal has recently undergone some alterations, and these are also fully described. Altogether this is perhaps the most important contribution to the subject that has appeared since Prof. Wild's famous memoir of 1873; for we can now rest assured that farther refinement is not required by any practical demands.

It seems to me that now that we are sure of the accuracy of Wild's normal, it is more necessary than ever that we should know with greater certainty its relation to the principal standards of Europe. I desire, therefore, to propose a plan by which a series of comparisons can be carried out for a few places at a very slight expense, and with as much accuracy as portable instruments will permit. In 1883 it became my duty to transport to America, from Hamburg three of the Wild-Fuess portable barometers of the highest grade; and it was of great importance to take every possible precaution against their being injured or their condition altered in any way so as to affect their readings. I devised a mounting on shipboard which was very satisfactory, and gave me no cause for uneasiness regarding the barometers, even in stormy weather. So many barometers are sent out from England to almost every country that I strongly urge the use of a similar arrangement in all cases where it is desirable to retain an assigned barometer correction.

The accompanying sketch shows my manner of mounting the barometers. Two small strips of wood, AA, are screwed to the woodwork running lengthwise of the vessel. They are placed about two feet apart, and are inclined at an angle of perhaps 45°. Small leather straps, say 15 inches long, are fastened to these strips by single screws as shown at BB. A rather soft stuffed flat cushion or pillow is now placed against the woodwork (wall) as shown at C. The box containing the barometer is now pressed against the cushion and the two extremities are placed within the grasp of the straps BB. These last are buckled and drawn tight enough to hold the barometer box firmly against the cushion C. The barometer is thus held in such a manner that no ordinary jarring can cause any damage to it, as there is no direct contact with a rigid surface, since the pillow prevents it from touching the wooden strips, and the soft yielding straps have a spring-like effect.

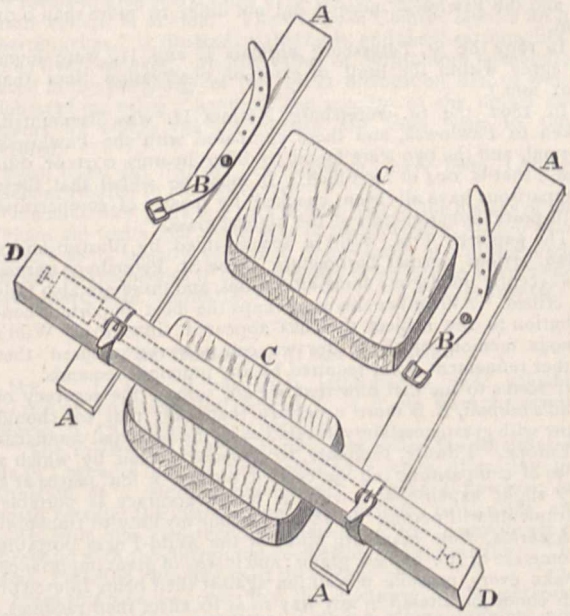
The lower part of the sketch shows the barometer box DD in position, with the barometer shown within it. Of course the cistern is held uppermost. On account of the jarring motion of the ship's screw in rough weather, it is desirable to locate the barometers well amidship, and also have the cistern of the baro-

meter directed towards the stern. Barometers can be placed in this manner on ship board by the maker, and can be left to themselves for any length of time. If the person to whom they are consigned is notified of their subsequent arrival at port, he can take them from their hangings on the ship in the best possible condition. Of course this presupposes an arrangement with the officers of the vessel, such that the instruments shall be let entirely alone from the time they are mounted by the consignor until they are received by the consignee.

I think this method of carrying instruments can be very usefully applied in improving our knowledge of the relation of international barometric standards, and at a minimum expense; and I will give a brief outline of a convenient way for accomplishing it. The Deutsche Seewarte at Hamburg, and the Kew Observatory at Richmond (through the London Meteorological Office), are in the best positions for supervising this work, and I venture to express the hope that the matter will be seriously considered.

I will outline the work when carried on from London.

Let two barometers of the best construction, say an Adie Fortin and a Wild-Fuess control barometer, be compared with the Kew normal during a period of a week or more, or long enough to experience considerable variation in the barometer



height. Then let the two barometers be mounted on one of the London Hamburg steamships, in the manner which I have described, and sent to Hamburg, where an employee of the Deutsche Seewarte could be despatched to take down the instruments and carry them to the Seewarte for comparison with the normal barometer. Then the barometers could be taken by a messenger to Lübeck, at an expense of a few shillings, and mounted on a St. Petersburg steamer, which would carry them almost to the door of the Central Physical Observatory, where they could be again taken in charge by a meteorologist, compared for a few days, and then again be mounted on another steamer bound for one of the Scandinavian ports where there is a standard barometer, and finally returned to London by one of the numerous regular steamships. At an expense of a couple of pounds the barometer could be sent from St. Petersburg (or Scandinavia) back to Hamburg *viâ* Stettin and Berlin; thus allowing Berlin to enter into the series. The barometers would probably have to be sent by a messenger from Berlin to Hamburg, thus entailing the just mentioned expense. A second comparison at Hamburg would be desirable, and then the barometers could be returned to London by sea, and again compared at Kew.

Similarly, barometers could be sent to New York for comparison with the sub-standard, by Adie, at the Maritime Exchange; although probably the United States Weather Bureau would assume the expense of the three pounds necessary to carry the instruments to Washington for comparison with the normal there, and then return them to New York and put them on shipboard to be returned to London.

The standard barometers of Australia, India, Brazil, and other countries accessible by sea can be reached from London (or Hamburg) in the same way, and the comparison instruments can be returned to their starting point for additional verification.

My own experience in the transportation of barometers assures me that ship captains would gladly give their hearty co-operation to a work of this kind, and there would be no charges for carrying the instruments even half round the world and back again.

In offering this suggestion it is not necessary for me to give the details for the complete organisation of such a scheme; but it may be remarked that if it should be undertaken, the personal experience of those who have been over the ground should be utilised in making plans. A single instance will serve to show why this is advisable. Some years ago I carried two barometers from Hamburg to London by sea. I took the German line of steamers and found myself anchored in the middle of the Thames, and had to get ashore as best I could. I greatly feared that I should never get the barometers ashore in a whole condition, as there was necessitated a great deal of scrambling over lighters, &c., and embarkation in an unsteady row boat in order to make a landing. Had I taken the English steamer, all this worry would have been saved. Other similar instances occurred which could have been avoided by one personally familiar with the routes to be travelled.

FRANK WALDO.

Princeton, New Jersey, February 20.

Motion of a Solid Body in a Viscous Liquid.

THERE is perhaps no branch of mathematical physics which has made greater progress during the last thirty-five years than hydrodynamics. During this period numerous important investigations have been published upon the motion of solid bodies in a *frictionless* liquid, upon the theory of discontinuous motion, upon the theory of vortex motion and vortex rings, upon the motion of a liquid ellipsoid under the influence of its own attraction, and upon waves and tides. These investigations constitute an enormous increase in the knowledge possessed by the present generation compared with that of its predecessors; they have to a considerable extent exhausted the field of research in the theory of the motion of *frictionless* liquids; but notwithstanding the importance of the results, the elegance of the methods by which many of them have been obtained, and the skill by which the mathematical difficulties have been surmounted, all the investigations referred to possess the defect of not accurately representing the motion of liquids as they occur in nature.

The reason of this discrepancy between theory and observation is that the ideal substance, which is called a *frictionless* liquid, has no actual existence, for all liquids which occur in nature are *viscous*. The viscosity of the mobile liquids, such as water, alcohol, &c., is a small quantity, being in the case of water equal to a tangential stress of about ·014 dynes per square centimetre; whilst in the case of the sticky and greasy liquids, such as treacle and oil, it is much greater. The viscosity of olive oil is about 3·25 dynes per square centimetre, and is therefore about 232 times as great as that of water.

The mathematical theory of the motion of viscous liquids was elaborated as long ago as 1845 by Sir G. Stokes, in a paper in which he showed that the effect of viscosity might be represented by certain additional terms in the equations of motion of a frictionless liquid, which contain as a factor a new physical quantity called the viscosity. In a subsequent paper, published in 1850, he applied the above theory to calculate the diminution of the amplitude of the small oscillations of a sphere surrounded by water; and by means of experiments in which this quantity was observed, he calculated the numerical value of the viscosity of water, and found that it was in close agreement with the value found by Poiseulle from experiments on the flow of liquids through capillary tubes. An investigation of a similar character was undertaken by von Helmholtz and Piotrowski about 1863, in which the sphere was suspended by a torsion fibre, and made to perform small torsional oscillations about a diameter.

Almost all calculations relating to small oscillations proceed upon the basis that the squares and products of quantities, upon which the disturbed motion depends, may be neglected. This introduces a great simplification into the work, and enables a variety of problems, which would otherwise be exceedingly intractable,

to be solved by fairly simple methods. There is, however, another class of problems of great practical importance, in which it is not allowable to neglect these quadratic terms, and towards the solution of such problems theory has as yet made little progress.

When a sphere is constrained to move along a horizontal straight line, but is otherwise free, it is well known that if the surrounding liquid is supposed to be frictionless, its only effect is to increase the inertia of the sphere by half the mass of the liquid displaced. The sphere accordingly requires a larger impulsive force to start it than if the liquid were absent, but when once started it continues to move with its velocity of projection. But when the sphere is surrounded by an *actual* liquid, its velocity gradually diminishes until it ultimately comes to rest; and this fact shows very forcibly the necessity of taking the viscosity of the liquid into account in problems of this character. I obtained a few years ago a mathematical solution, which shows that this effect must necessarily be produced by a *viscous* liquid, but the solution is an imperfect one, as mathematical difficulties compelled me to disregard the quadratic terms.

It is always a great advantage when the solution of a mathematical problem can be made to depend upon a *single* function which satisfies a partial differential equation and certain boundary conditions. This is always the case when a solid of revolution moves along its axis in a viscous liquid which is initially at rest, or has an independent motion which is symmetrical with respect to the axis. In this particular class of problems, the motion can be expressed by means of Stokes's current function in the following manner:—Let z be measured along, and r perpendicularly to the fixed straight line with which the axis coincides during the motion; let w and u be the velocities of the liquid in these directions; then:—

$$u = -\frac{1}{r}\frac{d\psi}{dz}, \quad w = \frac{1}{r}\frac{d\psi}{dr},$$

$$\left(\nu \mathrm{D} - \frac{d}{dt} - u\frac{d}{dr} - w\frac{d}{dz} + \frac{2u}{r}\right)\mathrm{D}\psi = 0,$$

where

$$\mathrm{D} = \frac{d^2}{dz^2} + \frac{d^2}{dr^2} - \frac{1}{r}\frac{d}{dr},$$

and ν is the kinematic coefficient of viscosity.

So far as I am aware, no serious attempt has been made to obtain a solution of this equation in a suitable form, even when the solid is a sphere. The equation is well worthy of the attentive consideration of mathematicians; and although it is an intractable one, it must be recollected that a general solution is not required, but only a particular one which is suitable in the case of a sphere. It will be quite time enough to consider the possibility of obtaining solutions of a more general character, when the appropriate one in the case of a sphere has been discovered. It is also important to recollect that in most problems which are of practical interest, ν is a small quantity (about ·014 in C.G.S. units for water), and consequently an approximate solution in which ν is supposed to be small would meet the exigences of the case.

When a solid body is moving through a liquid, one of the boundary conditions is that the normal velocity of the solid must be equal to the component along the normal of the velocity of the liquid in contact with it. If the liquid is frictionless, this condition is the only one which has to be satisfied; but when the liquid is viscous, a further question arises as to the law which expresses the effect of the tangential stress exerted by the liquid upon the solid. When the motion is very slow (as in the case of problems relating to small oscillations) the experimental evidence is in favour of the hypothesis of *no slipping;* but when the velocity is considerable, the experimental evidence is not so satisfactory. The partial slipping which takes place under these circumstances must depend partly upon the nature of the liquid, and partly upon that of the surface in contact with it; and the tangential stress to which it gives rise is probably approximately proportional to the square of the relative velocity.

When the motion is symmetrical with respect to an axis, the stresses due to viscosity can be calculated as soon as the value of ψ is known, the resistance which the liquid exerts on the solid can be found, and the equation of motion written down and integrated. This process is, however, an exceedingly tedious one; but it can always be dispensed with in the case of a single solid by employing the principle of momentum. When the motion is not symmetrical with respect to an axis, it cannot be expressed in terms of ψ; but if the velocities of the liquid can be found from the hydrodynamical equations, the components of the linear and angular momenta of the liquid can be calculated, and by applying the principle of momentum to the compound system composed of the solid and the surrounding liquid, the equations of motion of the former can be obtained. Since the momentum of the system is obviously a function of the six coordinates of the solid, this principle furnishes a sufficient number of equations for the determination of the motion.

When there is more than one solid, the principle of momentum is insufficient to determine the motion; but if the velocities of the liquid in the neighbourhood of each solid could be found, the force and couple constituents of the resistance could be calculated, and the equations of motion of each solid written down. Lagrange's equations in their ordinary form cannot be employed, as viscous motion involves a conversion of energy into heat; but problems which can be solved by an indirect method can usually be solved by a direct one, and I feel confident that equations analogous to Lagrange's equations exist, by means of which the motion of a number of solids in a viscous liquid can be found without going through the above-mentioned process. A form of Lagrange's equations has already been discovered, which is applicable when the viscous forces depend upon a dissipation function which is expressible as a homogeneous quadratic function of the velocities; and the circumstance that a dissipation function also exists in the hydrodynamical theory, although it is expressed in a different form, furnishes additional grounds for believing in the existence of equations of this character. The discovery of such equations would constitute an important advance in the theory of viscous liquids.

A. B. BASSET.

SCIENCE IN THE PUBLIC SCHOOLS AND IN THE SCIENTIFIC BRANCHES OF THE ARMY.

ON Friday last Mr. Campbell Bannerman received a deputation on this subject in his room in the House of Commons. There were present Sir Henry Roscoe, the Head Master of Rugby School, the Principal of Cheltenham College, the Head Master of Clifton College, Sir B. Samuelson, Prof. Jelf, and Mr. Shenstone. Lord Playfair, Sir John Lubbock, and Sir Henry Howorth would also have been present, but they were prevented by other engagements. The following is a brief account of the proceedings:—

Sir Henry Roscoe, in introducing the deputation, said that he had introduced a deputation on this subject to Mr. Stanhope about five years ago, and that if the suggestions then made had been adopted the present deputation would not have been necessary. After some remarks which showed the injustice of the present system to the more scientific lads, he pointed out several methods by which this injustice might be removed.

The Head Master of Rugby, Dr. Percival, expressed his strong feeling of the importance of the subject alike to the service, the cadets, and the schools, and said he wished to see both modern languages and science duly encouraged; he thought they might both be made compulsory, as he believed that early education should rest on a wide basis, and that specialising should only be encouraged later. Alluding to the work in science done at the Royal Military Academy, Dr. Percival mentioned that he knew of one cadet who, owing to the absence of any higher teaching there at the earlier stages, was lately learning science which he, the cadet, was well fitted to teach.

The Principal of Cheltenham College, Mr. James, confessed that his own interests and convictions on educational matters were those of a linguist rather than those of a man of science; but practical experience showed him that the present system told most unfairly against scientific boys who entered Woolwich; science was being gradually edged out. Many other head masters of public schools felt with the deputation. He thought also that the present system tended to the disadvantage of the smaller schools, where science was often exceedingly well taught. He hoped that in making any changes the authorities would be careful to consider the interests of linguistic boys, and

would not add to the number of subjects taken up at entrance, for boys were already overburdened in their preparation.

The Head Master of Clifton College, Mr. Glazebrook, said that this was a question on which the public schools had a strong claim to be heard, since an increasing number of boys passed direct from them to Woolwich—the proportion last July being about four-fifths of all the candidates. But the discouragement of science was not so serious to the great schools as to the smaller and less expensive schools, where as a rule science is well taught, but not German. He thought it undesirable that these latter should be debarred from competition. It was not only by the assignment of marks that science was now discouraged, but also by the system of instruction. Boys who went up to Woolwich tolerably proficient in chemistry were put back to the elements, and at the end of their first year knew less than when they entered. Such boys were naturally inclined to complain that science at Woolwich was a farce, and to urge their friends at school to take up another subject which was treated more seriously.

Further remarks were made by Sir B. Samuelson, who especially advocated the encouragement of all types of boys from the public schools, by Prof. Jelf, and by Mr. Shenstone. Statements were made by the Director-General of Military Education and the Inspector-General of Fortifications; the latter officer emphasised the importance of German and of electricity, and said many cadets were markedly deficient in the latter subjects when they left Woolwich. In concluding, Mr. Campbell-Bannerman expressed his obligation to the deputation, and his sense of the importance of the matter brought under his notice, which would have his most careful attention.

It will be seen from this report that the position of cadets of scientific ability at the Royal Military Academy is, as we pointed out some time ago, far from satisfactory, and that this view is now not only held by men of science but also by many head masters and by distinguished members of the military profession, who on this and on other occasions recently have spoken clearly on the subject.

The main defects of the present system seem to be:—(1) That science and German, two subjects which ought to go hand in hand in the early education of officers of the scientific branches, are at present brought into distinct conflict; (2) that in effect so great a bonus is given to German in the course of work at the Royal Military Academy as to be likely very soon to drive science out of the entrance examination, and to a corresponding extent out of the public schools; (3) that the standard of work of the cadets in science, and particularly in electricity when they leave the Royal Military Academy, is lower than it ought to be in very many cases.

Of these defects the last, which is doubtless largely the outcome of the first two, is probably the most important, and it will never be remedied so long as the authorities cling to the idea that a sufficient knowledge of several branches of science can be given to the cadets, even when they are quite new to such studies, in the moderate amount of time that can be spared for them during the comparatively brief course of work at the Royal Military Academy. That this idea is wrong we have pointed out again and again. If those who are responsible for the education of the cadets at Woolwich really desire that the cadets shall attain to a higher standard in science, they must not only encourage the admission of lads of scientific ability, but they must either set apart much more time to such work at the Academy, and give opportunities for, and more encouragement to, advanced work on the part of those who take up the subject, and do well in it at the entrance examination; or, if the giving of more time to science at the Royal Military Academy is impracticable, as is very possibly the case, they must so alter the conditions of the entrance examination as to secure that the cadets shall learn their elementary chemistry and heat at school, and be able to devote their science work at Woolwich wholly to electricity, which is technically of such great importance to them, but to which at present they can only give a portion of their time.

By doing this the authorities of the Academy will not only advance the interests of the service, they will also avoid that discouragement of the more scientific cadets and of the teaching of science in schools which is admittedly a result of the present system as a whole.

In conclusion, we would urge strongly what was pointed out by Sir Henry Roscoe on Friday, that it is not merely scientific knowledge but scientific ability which is wanted, and that it is only by giving due weight to science at the entrance examination and afterwards that this can be secured.

CLIMBING PLANTS.[1]

THIS forms the fourth part of A. F. W. Schimper's "Botanische Mittheilungen aus den Tropen," and is devoted to the description and illustration of the various adaptations for climbing exhibited by native Brazilian plants observed on the spot. Following Darwin, the author distinguishes four different classes of climbing plants, according to the manner in which they climb; but his four classes are not quite the same. Darwin divided them into those having stems which twine spirally round a support; those which climb by means of irritable organs; those which climb by means of hooks; and those which climb by means of roots. Darwin's investigations, it will be remembered, were chiefly directed to the elucidation of the phenomena exhibited by twiners, and such plants as climb by means of tendrils. Schenck treats in a general way of all four classes of climbers; and his work is more in the nature of a text-book than an account of experimental research. He divides climbing plants into Spreizklimmer, Wurzelkletterer, Windepflanzen, and Rankenpflanzen, corresponding nearly to the hook-, root, twining, and tendril climbers of Darwin and others. But the Spreizklimmer include all climbing plants that neither twine nor possess either irritable climbing organs or clinging roots, whether armed or unarmed. Thus the least organised of climbing plants are those having weak, slender, rampant stems and branches which grow up among other plants and rest upon them without any other means of support; whilst the most perfectly developed climbing plants are those provided with highly sensitive nutating tendrils, such as the Cucurbitaceæ and the Passifloraceæ. It is difficult to find an exact English equivalent for "Spreizklimmer," but "incumbent climbers" might be employed to designate this class. Twiners revolve with the sun, as the hop (*Humulus Lupulus*), or against the sun, as the scarlet-runner bean (*Phaseolus vulgaris*); but Schenck agrees with Darwin and other observers that they are not sensible to contact. It is only the plants classed as tendril-climbers that exhibit this property; and this irritability is developed both in caulomes and in phyllomes—that is in branches and in leaves, more or less modified for the purpose. In England there are only three woody climbers, namely: the ivy, a root-climber; the honeysuckle, a twiner; and *Clematis vitalba*, a leaf-stalk climber; but in Brazil, and in other tropical countries, they are exceedingly numerous, and present a great variety of adaptations to this end. Dr. Schenck, however, does not confine himself to Brazilian forms. He briefly reviews all the types that have come under his observation. Plants climbing by means of tendrils (irritable organs), conceived in the widest sense, are classified according to the organs, or parts of the organs, by means of which they climb. First he takes the leaf-climbers, which climb by means of

[1] "Beiträge zur Biologie und Anatomie der Lianen im Besonderen der in Brasilien einheimischen Arten." Mit 7 Tafeln. Von Dr. H. Schenck. (Jena: Gustav Fischer, 1892.)

sensitive revolving leaflets (*Fumaria*), by the petioles (*Clematis* and *Tropæolum*), by the tips of the leaves (*Tillandsia* and *Flagellaria*). Then come the leaf-tendril climbers proper, such as *Pisum sativum* and *Cobæa scandens*. But the almost peculiarly tropical branch-climbers, plants climbing by means of modified caulomes (branches or inflorescences), present the most singular forms. Dr. Schenck divides them into branch-climbers proper, which have elongated naked or leafy revolving branches clasping the branches of other plants; hook-climbers, which develop hook or claw-like supports; "watch-spring" climbers and thread-climbers. The grape-vine and passion-flower are classed under the last. The climbing organs of the "watch-spring" type are very curious. They are naked, attenuated branches, which roll up in one plane, forming a loose elastic spiral, between the coils of which the support is caught. The spirals usually thicken only at the point of contact, thereby effecting a firm hold of the support. Dr. Schenck does not enter deeply into the anatomy of climbing organs, though he states that differentiation of the tissues of sensitive organs only takes place after contact. The plates are all devoted to the illustration of the external morphology of climbing organs. A systematic list of genera containing climbing species is given, and there is also a chapter on the geographical distribution of climbing plants. W. BOTTING HEMSLEY.

CLAPHAM JUNCTION AND PADDINGTON RAILWAY.

THE statement that appeared in the press towards the end of last week, that the promoters of this railway had applied to the committee who rejected the bill for permission to bring the subject again before the House of Commons did not represent the fact. What really occurred may be gathered from the following extract from the *Times* of Saturday, the 25th inst.:—

"It had been the intention of the promoters of the Clapham and Paddington Railway Bill to ask the committee, presided over by Sir J. Kennaway, to grant permission to have the bill recommitted, in order to meet the objections as to electric traction raised by the Royal College of Science and the City and Guilds Institute. After a private consultation with the chairman, it has been decided that the public application to this effect should not be made until some arrangement has been come to with the authorities of these institutions in the Exhibition Road, and until steps had been taken to find out whether they would agree to the substitution of cable for electric traction on that portion of the line coming within the radius of the scientific colleges. . . . ."

Even the preceding corrected statement rather represents the aspect which the promoters would like the matter to assume than the strict truth. For as a matter of fact it has been pointed out first that the passage of the electric locomotives and the train of iron-framed carriages running nearly due north and south within some 40 feet of magnetometers would stop all work, even if the motive power were a cable; secondly, that the vibration caused by the quick moving trains and by the slapping cable would be ruinous; and lastly, that no one but an over-sanguine company promoter would imagine that an electric railway with a fragment worked by cable in the middle would be a lasting arrangement. Let but the bill pass, and within six months after the railway was open an interesting collection of broken cables would be on exhibition in the Houses of Parliament. It is amazing that the question of the shifting of the route of the proposed railway a few hundred yards to the east or west of Exhibition Road seems to be altogether neglected.

NOTES.

HONOUR has been done lately to two British men of science by the Academy of Sciences of the Institute of France. On March 6 Sir Joseph Lister was elected a Foreign Associate in succession to the late Sir Richard Owen, and on March 20 Sir Henry Roscoe was elected a Correspondent in the section of chemistry in succession to the late M. Abria.

THE Brazilian expedition, under charge of Mr. A. Taylor, for the observation of the solar eclipse has arrived safely at Ceara.

THE Liverpool Marine Biology Committee have recently appointed Mr. J. Henry Vanstone, from Prof. Howes' Laboratory at the Royal College of Science, South Kensington, as Resident Curator of their Biological Station at Port Erin in the Isle of Man. The important addition which has been made to the station during the winter, viz. a two-storied tank and aquarium house, is now finished, and will be open for use at Easter, when Prof. Brady, Mr. Thompson, Prof. Herdman, and several other biologists are going to Port Erin to work. Nine investigators and students have already applied for accommodation at the station during April, and others are coming at later periods during the summer, so there seems every prospect of the institution being well used this season.

IN connection with the conversazione to be held at the Royal College of Surgeons of England on July 5, to celebrate the jubilee of the Fellowship of the College, it has been decided, as this year is also the centenary of the death of John Hunter, to organise an exhibition of pictures, MSS., books, furniture, &c., connected with the great surgeon. In addition to the articles which are the property of the College of Surgeons, the exhibition will include other relics, the loan of which has been kindly promised by the present possessors. The librarian of the College will be pleased to give further information to any owner of Hunterian relics who may be willing to lend them for exhibition.

A VERY successful conversazione was held by the students of the Royal College of Science in the South Kensington Museum on Thursday, March 23. Mr. C. V. Boys concluded the various entertainments by exhibiting Mr. Henry Dixon's photographs of spiders walking on water, Lord Rayleigh's and his own photographs of bursting bubbles, and by showing his interesting experiments with soap bubbles.

THE council of the City and Guilds Institute for the Advancement of Technical Education have nominated the following as members of the Technical Educational Board of the London County Council, viz.:—Mr. Herbert Saunders, Q.C., Sir Owen Roberts, and Dr. W. J. Russell, F.R.S.

THE Camera Club announces that the seventh annual Photographic Conference will be held in the theatre of the Society of Arts on Wednesday and Thursday, April 12 and 13, under the presidency of Captain W. de W. Abney, F.R.S. Papers will be read by some of the leading students of photography, and all photographers are invited to take part in the conference.

SOME time ago the Egyptian Government appointed a commission to examine the building in which the archæological collection is housed at Ghizeh. This commission has now finished its investigations, and, according to the Cairo correspondent of the *Times*, its report shows the condition of the building to be even more dangerous than it was known to be. A fire would completely destroy the building in the course of a few hours. The Egyptian Government propose to have the Museum made fireproof at a probable cost of £90,000, but the result is not expected to be satisfactory. A new building on a

more accessible site would be very much better, but unfortunately the Egyptian Prime Minister declines to sanction the necessary expenditure, which would be about £130,000. He seems to have a very inadequate conception of the extraordinary interest and importance of this famous collection.

THE Göttingen Society of Sciences has recently proposed the following prize-subjects:—For 1893: From Röntgen and Kundt's researches on changes in the optical properties of quartz in an electrical field, there seems to be a close relation between the electro-optic phenomena and elastic deformations of that substance by electrostatic force. An extension of this inquiry to a large number of piezo-electric crystals of various properties of symmetry seems desirable; and attention should be given to whether the phenomena are due exclusively to the deformations occurring in the electric field, or also to a direct action of electrostatic forces on light motion. For 1894: Between the state of a hard elastic body and that of a liquid are a series of intermediate states, producible by mixture. The properties of these need elucidation by experiment; and especially it should be investigated how in the case of viscous bodies the laws of those movements vary, which, in the case of liquids of small viscosity, can be used to determine internal friction. Papers to be sent in with motto, &c., before the end of September in each year. The prize in either case is about £25.

THE following are the arrangements for lectures at the Royal Victoria Hall during April:—April 11, Principal Garnett, "Some Pioneers of Electricity," with experiments; April 18, Prof. A. C. Haddon, "The Life of a Papuan Savage," with lantern illustrations taken by the lecturer in New Guinea; April 25, Prof. Hudson Beare, "The Printing Press" with special reference to newspaper work.

MR. G. P. BAILEY writes to us that the meteor seen on Saturday, March 18, by the Dundee correspondent whose communication we printed last week was observed also at Kingsland, Hereford. Mr. Bailey was informed of it by the observer on the following day. From what Mr. Bailey can gather, the meteor appeared about 6.20 in a north-north-easterly direction. When first seen it was evidently nearing the end of its flight, and after moving towards the north-west for about three seconds it was hidden by an intervening hill. The trail left behind was visible for about twenty minutes. When first seen the altitude would be about 30°.

THE weather during the past week has been exceptionally fine in the British Islands, owing to anti-cyclonic conditions, which extended over the whole of western Europe. During the first part, the day temperatures were much above the average, generally exceeding 60°, and even reaching 69° in the Midland and eastern counties, while the nights have been very cold, with sharp frosts on the ground, and fog was prevalent in many parts in the early morning. The range of temperature has consequently been very large, exceeding 40° in the twenty-four hours on one occasion. On Sunday both solar and lunar haloes were visible at many stations in the south, and the anti-cyclone partially disappeared from western Europe; but these indications of disturbed conditions were only of a temporary character, although the barometer began to fall irregularly. The day temperatures became several degrees colder, owing to the persistence of easterly winds, but the readings were still high for the season. A special characteristic of the week has been the dryness of the atmosphere, scarcely any rain having fallen in any part of the British Islands, with the exception of a quarter of an inch measured at Valencia Observatory on the 25th instant. The *Weekly Weather Report* shows that for the first quarter of the present year there is a deficiency of rainfall in all districts, amounting to nearly four inches in the west of Scotland. The percentage of possible sunshine for the week ended the 25th instant was higher in nearly all districts than any obtained in the month of March since sunshine recorders were established, in 1881. The duration ranged from 36 to 66 per cent. in Scotland, 52 to 60 in Ireland, and 62 to 82 in England, while in the Channel Islands the percentage was 91°, being a higher weekly value than hitherto recorded at any time of year.

THE Deutsche Seewarte has recently published part v. of the observations made under its auspices beyond the sea. The stations now number sixteen, of which six are in Labrador, five in Africa, one in each of the following places:—Korea, Apia (Samoa), Brazil, Arabia, and Persia. Four of the stations included in this part are new, viz. Tripoli, Baliburg (West Africa), Apia, and Campinas (São Paulo). The observations are taken thrice daily, with good instruments, and all needful particulars are given about the stations, so that the series forms a very valuable contribution to our knowledge of the meteorology of remote regions.

WE have received from Mr. S. B. J. Skertchly an account of a remarkable cold wave which passed over the southern part of China in January last. Since the establishment of the Hongkong observatory in 1884 the lowest temperature observed in any previous month was 40°·3, and this did not last more than an hour, but from January 15 to 18 inclusive the thermometer did not rise above 46°, and fell as low as 32° at the sea level on the 18th. Simultaneous observations collected for 4h. p.m. from other localities show that the cold wave travelled a considerable distance from the north to the south of Hongkong. The readings were:—Canton 37°, Hongkong 35°, Macao 36° on the 16th, and Haiphong 46° on the 17th. The comparative severity of the cold is also shown by the following values deduced from Hongkong observations for January 1884-8:—Mean minimum 56°·1, absolute minimum 41°·8. Dr. Doberck reported that neither snow nor hail was seen in Hongkong, but the hills appeared to be covered with snow or hoarfrost, and a few hundred feet above the sea level both the grass and branches of the trees were covered in unusually clear and transparent ice, without any appearance of crystallisation. The Chinese, who had never seen such a sight, brought down a quantity and sold it as medicine. At Macao, however, a quantity of soft hail fell and lay from 3 to 6 inches in depth where the wind had drifted it. The effect upon vegetation a few hundred feet above the sea was disastrous; nearly all the trees seemed burnt up, and nearly the whole of the butterflies on the wing were killed. This was the coldest spell known to have occurred in China for over fifty years, and it was apparently due to a tongue of cold air being pushed below the warmer stratum. The atmospheric circulation at the time was anticyclonic, and snowstorms were reported from the northward and eastward of Hongkong.

THE Central Physical Observatory of St. Petersburg has commenced from January last the issue of a monthly meteorological bulletin referring to European Russia. It contains four pages of tabular matter, one of which includes the observations taken at 73 telegraphic reporting stations, and the other three contain rainfall observations taken at 312 stations, all the monthly means being calculated according to the Gregorian calendar. The tables are followed by a general discussion of the weather of the month, and of the various meteorological elements, and, lastly, a map is given showing the mean monthly isobars, isotherms, and distribution of rainfall. With the exception of the preface, which Dr. Wild has translated into German on a fly-leaf, the whole of the work is written in Russian, which, although one of the most methodical of modern languages, is not yet generally read in Western Europe, so that the usefulness

of this valuable publication is more restricted than it otherwise would have been.

AN instructive record of medical experience at Davos Platz is given by Dr. Spengler in *Fortschritte der Krankenpflege*. It relates to the two and a half years from November 1887 to May 1890. Communication is kept up with patients after leaving, and the statistics give, in 177 cases, 28·8 per cent. (51 cases) as "cured," 14·0 per cent. as "perfectly fit for work," 17·0 as "still ill," and 31·6 as dead. (In 17 cases, or 9·6 per cent., there is no record.) Thus, a permanent cure seems to have been effected in 42·8 per cent. of the cases. It is noted that most of the patients were subject to influenza in the epidemic of 1889–90. Dr. Spengler gives details of the treatment followed at Davos. We note that, at the outset, till acclimatisation is completed, and the patient has slept well one or two weeks, he lies much in the open air, and takes little exercise. Patients who come with fever soon lose it, and for this reason Dr. Spengler has found Koch's much denounced tuberculin advantageous in certain cases, and still makes use of it. The local or valley wind at Davos is always from the north-east, so that patients can enjoy the sun on the south side of the houses; and in this Davos has an advantage over the Engadine valley (also lying north-east to south-west), where the valley wind is from the south-west.

PROF. ELIHU THOMSON in the *Electrician* gives an account of a curious case of the apparent attraction of closed circuits by an alternating magnetic pole. He finds that when a disc of copper is brought near the pole of an electro-magnet traversed by an alternating current it is at first repelled, but that if its diameter is less than that of the core of the magnet, the repulsion diminishes as it gets nearer and at last becomes an attraction. The explanation given is that the currents induced in the disc, on account of its small diameter, do not suffer as great a lag as when induced in rings or discs which surround the pole; hence the repulsion is feeble, so that it is at last overpowered by the attraction between the induced currents and the iron of the core.

AT a recent meeting of the Société Française de Physique M. d'Arsonval gave an account of his experiments on the physiological effects of electric currents of high frequency. The currents used ranged from one-half to two amperes and were obtained as follows. The internal coatings of two small Leyden jars were connected to the terminals of a large Rhumkorff coil, while the internal coatings were connected through a spiral of from fifteen to twenty turns of thick copper wire. When a spark passes between the terminal knobs of the coil, oscillations are set up, and on account of the self-induction of the spiral of wire if the person or tissue to be experimented on is connected to the two ends of this spiral it will be traversed by a current of very high frequency. The following results were obtained:—(1) The currents are not felt although they are of sufficient strength to light up a lamp requiring two amperes, when held between two persons who complete the circuit. (2) The power of feeling the effects of currents of low frequency is diminished in all parts of the body traversed by these high frequency currents. (3) Zones are formed round the electrodes (which consist of wet sponges) in which all sensitiveness to pain is for the time being lost. (4) A remarkable effect is observed on the nerves which regulate the size of the blood-vessels (vaso-motor nerves), for the vessels dilate to such an extent that in some cases, when an animal was subjected to the current, the arterial pressure fell more than a quarter of its normal value. M. d'Arsonval maintains that these observations show that the reason these currents are not felt cannot be owing to their being confined entirely to the skin. He also suggests as the true explanation that the frequency is so high that the sensory nerves are not affected, just as the auditory and visual nerves are not sensitive to vibrations of certain frequencies.

THE Royal Commission appointed to investigate the condition and education of the blind, the deaf and dumb, &c., did everything in its power to secure the best evidence that could be obtained. Among those who brought forward facts as to the deaf were the well-known American authorities, Dr. E. M. Gallaudet and Dr. A. G. Bell. Last year their evidence was printed in America, with some other matters, in a separate volume, and an elaborate index was prepared by Dr. J. C. Gordon. This index has been carefully revised, and has now been issued by the Volta Bureau, Washington, the compiler having added to its value by the preparation of various "notes and observations." The volume may be of considerable service to serious students of the subject.

THE *Board of Trade Journal* gives an account of a very interesting report prepared by M. P. Mouillefert, Professor at the National School, Grignons, on the vineyards of Cyprus. He thinks that by its situation, its broken surface, its general incline, rising from sea-level to an altitude of over 6000 feet, Cyprus offers the most varied and favourable conditions for the cultivation of the vine. This cultivation is, even at the present day, of real importance, not only from its area, which covers almost 145,090 deunums (100 deunums = 2·47 acres), but from the value of the produce it yields, which exceeds 3,500,000 francs, and affords a livelihood to over 10,000 families. The method of cultivation, however, and the manufacture of the wine fall far short of what they should be, and this is owing to the ignorance and the poverty of the people. M. Mouillefert gives elaborate instructions as to the changes of method which he considers necessary, and expresses his belief that if they were adopted Cyprus might become "the vineyard of Great Britain." One of his proposals is that a professor of agriculture should be appointed who would confer with the villagers and gradually induce them to adopt the proper system of vine cultivation. Meetings and exhibitions, at which prizes were given, would also, he thinks, be an excellent way of encouraging the producer to improve his method of cultivation and his produce.

IN the current number of the *Mediterranean Naturalist* it is noted that upwards of 60 per cent. of the earthquakes that have been recorded have occurred during the six colder months of the year—the maximum number in January and the minimum number in July. These are the results of calculations for the whole area of the globe. The calculations made for separate earthquake districts are said to be in full accord with them, and to show in some cases even a greater proportion for the cold than for the warm season. This is especially the case in the Mediterranean area, where the number of shocks experienced during December, January, and February are to the number felt during June, July, and August as 5 to 2.

THE Technical Instruction Committee of the Essex County Council has published what it calls a "Report and Handbook." The volume contains a most creditable record of work done during 1892, and ought to be of no small service to similar committees in other parts of the United Kingdom.

MESSRS. GAUTHIER-VILLARS have issued the fifteenth report of the International Committee of Weights and Measures. The report relates to the work done in 1891.

THE fifth volume of the "Œuvres Complètes de Christian Huygens" has just been published. It consists of correspondence carried on in 1664–65. This magnificent edition, to which we have repeatedly called attention, is being issued by the Société Hollandaise des Sciences.

MESSRS. J. B. BAILLIÈRE ET FILS, Paris, have issued the first volume of a work entitled "Éléménts de Paléontologie," by Félix Bernard. No fewer than 266 figures appear in the text. The same publishers have issued in their "Bibliothèque Scientifique Contemporaine" a book on "Les Lichens," by A. Acloque. He deals with the anatomy, physiology, and morphology of the lichenic organism.

MESSRS. GEORGE BELL AND SONS have issued the second volume of Mr. George Massee's "British Fungus-Flora," a classified text-book of mycology. The work will be completed in three volumes.

PROF. B. KOTÔ has contributed to the Journal of the College of Science, Imperial University, Japan (vol. v. part 3) a learned paper on the Archæan formation of the Abukuma Plateau. The paper is illustrated with several plates.

MESSRS. BAILLIÈRE, TINDALL, AND COX have published a second edition of Veterinary Captain F. Smith's "Manual of Veterinary Hygiene." The only important alterations in the book are those in the chapter on ventilation.

A VALUABLE "Catalogue of American Localities of Minerals," by Prof. E. S. Dana, has been reprinted by Messrs. John Wiley and Sons from the sixth edition of Dana's "System of Mineralogy."

THE Wagner Free Institute of Science proposes to issue a reprint of T. A. Conrad's monograph of "The Medial Tertiary Fossils of the United States," if subscriptions for 150 copies can be obtained. The original plates would be reproduced by a process of photo-engraving, and a brief introductory chapter and a table would show the present state of the nomenclature of the species contained in the work.

STARTING with an observation by Herz, that the cathode rays causing phosphorescence can pass through thin metallic plates, Herr Lenard has recently made some interesting experiments (described to the Berlin Academy) with an arrangement in which the rays from a small aluminium disc (as cathode) were projected on a thin aluminium "window" (0·003 mm. thick), in a thicker metal plate at the opposite end of the tube. The lateral anode was connected to earth, and a large inductorium was discharged through the tube. These cathode rays passed through the window, and made the air faintly luminous, with bluish light, brightest at the surface of the window. There was a strong smell of ozone. Phosphorescent bodies, bodies brought near the window, glowed, having the same colour as *in vacuo*. At about 2·4 inches distance the phenomenon ceased; it also ceased when the cathode rays were deflected with a magnet, or when a screen of sufficient thickness was interposed. But owing to diffuse spread of the rays the phosphorescent action extended into the shadow of the opaque screen. This field of observation beyond the window could be enclosed and evacuated, and the higher the vacuum, the greater was the distance at which phosphorescence took place, and the sharper and brighter were the rays—indicating (in the author's opinion) that these cathode-rays are a process in the ether. Herr Lenard tried other gases besides air, and found varying penetration by the rays. When coal gas was let pass between the window and the phosphorescent body the latter brightened. When the field of observation (enclosed) was filled with hydrogen at atmospheric pressure, the phosphorescence extended thrice as far as in air at the same pressure (viz. to about 8 inches). Oxygen and carbonic acid were less penetrable than air. "One may say that hydrogen molecules cause less turbidity in the ether than those of oxygen, and the latter less than those of carbonic acid."

NOTES from the Marine Biological Station, Plymouth:—Last week's captures include the Nemertine *Lineus marinus* (=*longissimus*) and the long-spined sea-urchin (*Echinus acutus*). In the floating fauna the principal change has consisted in a great reduction in the numbers of Echinoderm larvæ and in the gradual disappearance of *Aurelia*-ephyræ, as well as in the appearance of numbers of *Arachnactis* (larva of the Actinian *Cereanthus*), of the Leptomedusa *Irene pellucida* (Claus, *non* Haeckel), and of a few *Porcellana* larvæ. In addition to these, small *Obelia* medusæ and the Appendicularian *Oikopleura dioica* have been abundant, and young Ctenophores and Planarians have been occasionally present. The Hydroid *Eudendrium ramosum*, the Nemertine *Amphiporus pulcher*, and the crab *Portunus arcuatus* are now breeding.

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythus*, ♀) from Zanzibar, presented by Mr. C. E. Reynolds; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. J. W. Jones; a Coypu (*Myopotamus coypus*) from South America, presented by Mr. Arthur Hunt; a double-banded Sand Grouse (*Pterocles bicinctus*) from Senegal, presented by Mr. H. H. Sharland, F.Z.S.; three Common Peafowls (*Pavo cristatus*, ♂ ♂ ♀) from India, presented by Mr. W. Murphy Grimshawe; ten —— Fishes (*Giradinus guppyi*) from Trinidad, presented by the Marquis of Hamilton; a Hawfinch (*Coccothraustes vulgaris*), four Bramblings (*Fringilla montifringilla*) British, purchased; a Hog Deer (*Cervus porcinus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES (1892 III.).—Prof. Keeler, in speaking of the hypothesis that this comet has been produced by a collision between two asteroids, says that the character of the spectrum has little to support this view. He accounts for the brightening on January 16 by supposing that an increase in the number of reflecting particles in the space surrounding the comet took place, *i.e.* by an increase of density, which might result from a contraction following the previously observed expansion of the comet, or, which is more in accordance with the observations, from fresh emanations from the nucleus (*Astronomy and Astrophysics* for March).

Apropos of the same hypothesis, Prof. C. A. Young queries whether, if the asteroids were formed by a series of "explosions," breaking up first the original planet and afterwards the pieces from it, this might not be an event of that sort—an eruption from an asteroid. We continue the ephemeris for the week:—

12h. Paris Mean Time.

1893.		R.A. (app.) h. m. s.		Decl. (app.) ° ′ ″
March 30	...	3 20 48·7	...	+36 7 2
31	...	22 38·7	...	9 44
April 1	...	24 28·9	...	12 25
2	...	26 19·2	...	15 5
3	...	28 9·7	...	17 44
4	...	30 0·3	...	20 22
5	...	31 51·1	...	22 58
6	...	3 33 42·0	...	36 25 33

WOLSINGHAM OBSERVATORY, Circular No. 34.—The star Es-Birm 180 6h. 15·5m. + 47° 43′ was found to be 10·5 March 20 and is variable. On March 18, a red III. Type star, 8·5 mag. was seen at 3h. 23·5m. + 58° 11′ and may be variable. Not in D.M. Places for 1900.

JUPITER AND HIS SATELLITES.—Writing from Arequipa, Peru, Prof. Pickering communicates to *Astronomy and Astrophysics* for March an account of the very valuable and important observations that he made during the past favourable opposition of the planet Jupiter. A minute study of the planet's surface gave him the impression that his surface consists of a "uniform white mass of cloud," over which is stretched a gauzy and thin veil "of a brown material, resembling in struc-

ture our cirrus clouds. Where this veil occurs in denser masses there are the belts, and the phenomena of white spots is nothing less than holes in this veil itself exposing the uniform white layer below. During this period of observation the great red spot was extremely faint and seemed to belong to the white portion beneath, being apparently seen through a hole in the gauzy structure. Since October 8 last, when Prof. Pickering commenced a series of measures with the 13-inch telescope of the diameters of the satellites, some most interesting results have been forthcoming. It was on that day also that he observed one of these small bodies first as an elliptical figure, and then afterwards as a circular one, and later he had the good fortune to watch and observe the disc as it gradually began to assume the elliptical form. After this observation it was found that the other three satellites had at some time been reported as representing an elliptical disc, the shortening taking place equatorially, thus they would seem to revolve about their minor axes. To make quite sure that this was the case and not the result of some optical delusion, Prof. Pickering seems to have instituted various experiments, but the elongations, as he says, "nevertheless remained persistent in the same direction." The first satellite then is a prolate ellipsoid revolving about one of its minor axes in a period of 13h. 3m., while the other three assume at regular intervals the form of ellipses, these periodic changes being produced by the rotation upon their axes.

With respect to the second satellite, the shape of which, by the way, is put down as that of an ellipsoid of three unequal axes revolving about the middle one, and whose period of rotation is 41h. 24m., a curious observation was made in December last. Just about the time of occultation, the equatorial diameter being "decidedly shortened," the satellite retained its shape until almost in contact with the limb, when suddenly "the major axis of its ellipse changed its position angle through thirty degrees, becoming parallel to the limb of the planet." With regard to the other two satellites Prof. Pickering mentions many new facts relating to colour, size, rotation, &c., too numerous to refer to here, but we may say that he has been led to the conclusion that all the four satellites are nothing more than condensed swarms of metorites, like Saturn's ring. In the case of each satellite he gives an ephemeris which indicates the time at which each presents its maximum elliptical phase.

THE HORIZONTAL PENDULUM.—In a volume of 216 pages entitled "Das Horizontal Pendel und seine Anwendung zur Beobachtung der absoluten und relativen Richtungs-Aenderungen der Lothlinie," Dr. E. von Rebeur-Paschwitz brings together all his observations made in the years 1889–92 at the observatories at Wilhelmshaven and Potsdam, and also in Puerto-Orotava on Teneriffe. Besides containing a long discussion on the observations themselves, a very useful collection with short notes of the literature on this subject is added. The pendulum, which was of an isoceles triangle shape, carried a small mirror at the middle part of the shortest side, the movements of which were photographically recorded with the help of sensitised paper and an oil lamp. In addition to numerous seismical appearances, three distinct periodic pulsations were recorded. The first he says is with great probability due to the different positions of the moon, and after supplying the terms containing lunar factors he finds a close agreement between the observed and calculated values—the observations indicating the existence of a tide with a coefficient of 0″·01. With regard to the daily period, he finds that these movements are by no means local, but quite general over the earth's surface; the real cause of these motions do not seem to have been fully brought home, as the magnitudes of the amplitudes seemed to differ considerably locally; but in a note Dr. Paschwitz mentions that the action of the moon on the daily period is in all cases of great importance. The third and last movement, that of the motion of the zero-point, seems to be totally dependent on meteorological conditions.

THE RISING AND SETTINGS OF STARS.—At the present day there are many who are interested in the calculation of star places, times of rising of stars, &c., for times very remote, such as, for instance, in the solution of such problems that have arisen with regard to the orientation of temples, occultations, eclipses, &c. Where we now use the meridian, our early ancestors adopted the horizon, and it was to this plane that they referred many of their astronomical measurements. The heliacal rising and setting, and the cosmical rising and setting are only some of the expressions that were in use to define different relations between heavenly bodies and the horizon at a given time, and only quite recently has the importance of such terms as these been pointed out. In a late publication of the *Astronomischen Gesellschaft*, Bd. xx. Dr. Walter F. Wislicenus has worked out a set of tables for the computation of the yearly risings and settings of stars, and the special problems which can more easily with their help be solved may be stated as: (1) Given ϕ, ϵ, α, δ the latitude, obliquity of ecliptic and coordinates of a certain star for a certain year to find the longitude of the sun at the time of the heliacal rising. (2) Given ϕ, ϵ, for a certain date, and λ for the heliacal rising of an unknown star to find α and δ. (3) Given ϵ, α, δ, for a certain date and also the value of λ at the time of the heliacal rising to find ϕ the place of observation.

GEOGRAPHICAL NOTES.

FRENCH exploration towards Lake Chad is being carried on steadily and successfully. The latest results have been obtained by M. Maistre, who set out from the Mobangi in July, 1892, traversed the south of Bagirmi through the Shari valley, and entered Adamawa by a route never before traversed by Europeans, ultimately descending the Niger, where the expedition reached Akassa on March 25. The health of the expedition was good, and in the earlier part of their work friendly relations were kept up with the natives. In Adamawa, however, there were hostile encounters.

MR. MACKINDER concluded his course of educational lectures for the Royal Geographical Society last week by a masterly discussion of some of the geographical aspects of British history. The effect of the position of the British Isles on their history was summarised concisely in the statement that Britain stands out of the continental world, yet looks into it through its south-east window, and looks not merely into the world, but into the great historic avenue of the world's life. Naturally, therefore, the centre of Britain's national and commercial life has been drawn eccentrically to the south-east corner. This accounts for the inevitable position of London. The configuration of the country, with its natural zones of highlands and lowlands, led with equal clearness to the distribution of peoples and interests, which caused the historic opposition of England and Scotland.

MR. AND MRS. THEODORE BENT, after some delay at Massowa, on account of tribal wars, reached Adowa on the way to Aksum in the middle of February. At Adowa there are Himyaritic ruins of some importance, which Mr. Bent proposes to study before going on to Aksum, where he hopes to have several weeks of active archæological research.

IN a recent report on the triangulation of the north-west portion of South Australia, published by the Government of that colony, the work of the surveyors during the last few years is briefly summarised. From 1888 to 1890 16,000 square miles were surveyed in the form of a belt, about fifty miles wide, stretching from the Anthony Range to the western boundary of the province, a distance of 320 miles. Up to the end of the 1892 season 11,300 square miles of additional land were surveyed. The work in many places was extremely arduous on account of want of water, a supply for the camels having sometimes to be carried for more than forty miles, and for more than a year no rain whatever fell.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual spring meeting of this Institution was held last week in the hall of the Society of Arts on Wednesday, Thursday, and Friday, March 22, 23, and 24. There was a fair number of papers on the agenda, of which the following is a list:—

On the present position of the cruiser in warfare, by Rear-Admiral S. Long. Merchant cruisers considered with reference to the policy of maintaining a reserve of vessels by annual subventions to shipowners, by Lord Brassey. Some considerations relating to the strength of bulkheads, by Dr. F. Elgar. On the measurement of wake currents, by George A. Calvert. On the new Afonasieff's formulæ for solving approximately various

problems connected with the propulsion of ships, by Captain E. E. Goulaeff, Imperial Russian Navy. Some experiments on the transmission of heat through tube-plates, by A. J. Durston, Engineer-in-Chief of the Navy. Some notes on the testing of boilers, by J. T. Milton, Chief Engineer Surveyor, Lloyd's Registry of Shipping. On an apparatus for measuring and registering the vibrations of steamers, by Herr E. Otto Schlick. On the repairs of injuries to the hulls of vessels by collisions, stranding, and explosions, by Captain J. Kiddle, R.N. On approximate curves of stability, by W. Hök. Some experiments with the engines of the s.s. *Iveagh*, by John Inglis. On the cyclogram, or clock-face diagram, of the sequence of pressures in multi-cylinder engines, by F. Edwards.

Admiral Long's paper was the first taken, and was a useful contribution to a subject which is more of a military than an engineering or constructive interest. Lord Brassey's paper, on the other hand, is chiefly of interest to the shipowner from a commercial point of view, although a very wide imperial matter is encompassed within the scope of the paper. Lord Brassey maintains that this country cannot maintain her supremacy in first-class ocean liners of high speed, and carrying small quantities of cargo, in face of the foreign competition supported by state subsidies. Our own post-office contribution for carrying mails is insufficient for the purpose of enabling British shipowners to compete with those of foreign states. In the humbler class of ocean cargo steamers we can hold our own, as proved by the figures quoted. The matter is well worthy of the attention of statesmen. Admiral Long's and Lord Brassey's papers were discussed together, and occupied the whole of the Wednesday morning sitting.

On the Thursday, the second day of the meeting, a paper by Dr. Elgar was the first on the list, and is the outcome of some remarks made by the author in a speech during the discussion of Mr. Martell's paper of last year upon a similar subject. Dr. Elgar refers to the report of the Board of Trade Committee upon the spacing and construction of water-tight bulkheads in ships, saying that this report raises broadly and pointedly the question of how the strength of a large area of perfectly flat thin steel plating, which is supported at the edges and subjected to normal pressure, may be determined by calculation. This, the author says, is the simplest form of the question thus raised. In applying it to the case of a ship's bulkhead we require to deal with a continuous area of plating whose thickness is uniform, but with an area made of separate plates of varying thickness, and connected with riveted joints, which has stiffening bars riveted across in parallel lines at equal distances apart. Dr. Elgar pointed out that what is required is further experimental data upon which to base a theory of use to ship-designers in determining these points. In the discussion which followed Dr. W. H. White, the Director of Naval Construction, and assistant controller, supported the author's contention, as also did Mr. Martell, the chief surveyor of Lloyd's, and Mr. Bryan, of Cambridge. The two former, who, it is needless to state, are influential members of council, advocated that a research committee should be formed for the purpose of investigating the matter and accumulating experimental data. Sir Edward Harland, who was chairman of the Board of Trade Committee before referred to, opposed this suggestion on the ground that the Board of Trade Committee had made experiments sufficient for the purpose, and until those experiments had been proved to be defective he thought that any further sums spent would be largely wasted. We do not think the meeting was in accordance with Sir Edward's views. As Dr. White pointed out, the experiments made under the supervision of Sir Edward Harland were more of the nature of experiments on individual girders, rather than on plated surfaces, supported by stiffeners, the stiffeners being treated as the girders. As Mr. Bryan said, what ship-builders really want is a rule based on scientific investigation by which they can be guided in cases where there is not absolute experimental data. We quite agree with Mr. Bryan that this subject wants to be lifted out of the region of empiricism which has always surrounded it. There is, however, not much prospect of the committee of the Institution being formed, not on account of its being unnecessary, but because there are not sufficient funds at the disposal of the Institution. Dr. White was anxious that the members should be asked to express formal approval of the step to be taken in carrying out this investigation, in order to strengthen the hands of the council. We think, however, that no strengthening of this nature is requisite, for, if we mistake not, such work as this is directly within the scope of the Institution, as set forth by the original design upon which it is based.

Lord Brassey, who occupied the chair, advised that the council should memorialise the Board of Trade in order that the Government might take the matter up. No doubt if such a step be taken, a committee will be formed, and those members who have taken a prominent position in the discussion of these matters would no doubt be willing to act—in fact they could not very well refuse. It is to be hoped also that Mr. Bryan, although not a member of the Institution, will be included in the list. It is very desirable that practical consideration should be kept strictly in view in such a matter as this, but in order to be practical, the investigation should be based on a scientific foundation. There are several naval architects who are mathematicians in the best sense of the word. Mr. Bryan is, however, a mathematician first, and that of a very high order, having distinguished himself at Cambridge. His grasp of mechanical subjects has also proved considerable, as evidenced by the original work done at the Cambridge Philosophical and his contributions to the British Association. His paper on the buckling of the thin plate will be remembered in this connection, and since then he has turned his attention to a study of the buckling of plates. His inclusion in the committee would be a guarantee that any experiments made would include the whole subject and not be simply girder tests.

Mr. Calvert has take up a very interesting subject for investigation. The measurement of a steamer's wake is a problem that has been looked on by many as practically insoluble, but Mr. Calvert has attacked it in a practical and philosophical manner. He has towed a large vessel, 260 feet in length, measuring the velocity of the wake by means of towing logs. This vessel was towed from Holyhead to Liverpool. Unfortunately the experiment was not so successful as might have been hoped. The speed of the vessel varied during the voyage and the logs only showed the average. The action of the rudder also affected the stream-lines. There were other sources of error. The author therefore was reduced to model experiments, the vessel he used was 28½ feet long, and 3·66 feet draught. Across the stern was fitted a framework upon which several fine vertical wires were stretched, extending from the deck to some distance below the keel, each of these wires, and the apparatus connected with it, being exactly similar to its neighbours. Upon the wires at the level at which the weight measurement was required a horizontal tube, ⅛ inch internal diameter, was carried by a universal joint near its forward open end. The end of this tube was in communication with another tube, closed at its upper and lower ends, and hung by trunnions to one end of a weighted lever. One of the trunnions being hollow formed a connection through the rubber tube to the under side of a gauge glass inside the model, so that through this system of jointed tubes there was free communication between the gauge glass and the water outside. On the after end of the tube four thin radial feathers were fixed, and as the weight of that end of the system of tubes was accurately balanced by a lever, the horizontal tube necessarily assumed a position parallel to the direction of any current in which it might be placed, and its open forward end was consequently always presented normally to the current.

In order that the attitude of the submerged tube might be noted by the observers in the boat, the vertical tube carried a light rod, the top of which indicated the inclination in any direction of the tube; four or five of such horizontal tubes were fitted at one time, each on its vertical wire, and having its connections as described, and another such tube with similar connections was carried by an outrigger reaching out into water that was practically undisturbed. Records were taken by means of a photographic camera. If the water into which these horizontal tubes advanced were at rest, or if its velocity throughout were uniform, then the water in the gauge glasses, rising higher and higher as the speed increased, would still stand at the same level in all the glasses. Assuming that the tube carried by the outrigger was always advancing into undisturbed water, then the water in the gauge glass connected with that tube would serve as a datum line from which, at that instant, the relative elevation or depression of the water in any other gauge glass could be measured, indicating to its corresponding horizontal tube that the water through which it was passing was either following or meeting the boat. The wave of the boat was a disturbing element which had to be allowed for. The data being appraised

by means of photographing the waves' profile. The author also towed a flat plank, 28 feet long, at a speed of 406 feet a minute. The speed of current recorded at distances of 1 foot, 7 feet, 14 feet, 21 feet, and 28 feet from the leading end were respectively 16 per cent., 37 per cent., 45 per cent., 48 per cent., and 50 per cent. of the velocity of the plank. These proportions appear to be maintained at all speeds between 200 and 400 feet per minute. Having thus determined the maximum velocity of the frictional water, other experiments were made with this plank to show the manner in which the motion of the water in contact with the surface was gradually imparted to the layers of water lying underneath. This was done by means of tubes, the forward ends of the tubes being open, and their after ends connected to gauge glasses. The results of experiments at 200, 300, and 400 feet per minute would appear to show that the velocity decreases in a geometrical progression as the distance from the surface increases in arithmetical progressions. The retardation of velocity in the somewhat analogous conditions of orbital wave motion of the flow of rivers, and possibly of glaciers, appears to confirm the foregoing observations as regards the ratio of decrease in velocity of the frictional weight. Mr. Calvert next went on to refer to the labours of Dr. Froude, and his report to the British Association for 1874. We regret that space does not allow us to accompany him in this most interesting investigation, and we must refer our readers to the Transactions, in which the whole matter will be published in full. In the discussion which followed, Dr. White, Mr. Froude, and others spoke, but no new facts were brought forward.

The next paper of interest was a contribution by Mr. A. J. Durston, Engineer-in-Chief of the Royal Navy, and dealt with the important matters which are comprised in the problem of leaky tubes. Our readers will be aware of the trouble that has arisen in the Navy from the leakage at tube-plates and tube-ends, where marine boilers have been driven to their maximum. The difficulty has been got over to a certain extent by the introduction of a peculiar form of ferrule. These ferrules are bent over at their ends and protect the joint of the tube and tube-plate from the fierce impact of flame. Naturally the ferrules themselves get burnt away, as there is an air space between them and the heated surface of the boiler by which the heat would be abstracted from the end. With malleable cast-iron, the destruction is not so rapid as one would imagine, for, we believe, although the fact was not stated at the meeting—that a spare set is all that is provided for a commission, that is to say, two sets of ferrules, one in position and one spare will last for three years. The experiments upon which Mr. Durston's paper is founded were made in various ways, with parts of boilers constructed especially for the purpose. The temperatures were generally ascertained by means of plugs at fusible alloys let into the plates through which the heat was transmitted. An interesting series of experiments was also made as to the temperature of the products of combustion at different distances within the tubes of a boiler. This was done by means of a Le Chatelier pyrometer. And it may be said that the curve of temperatures obtained in this way agrees very closely with the curve of evaporation obtained by Mr. Wye Williams. We have not space to give the details of Mr. Durston's many trials. One very striking thing was the extremely deleterious result of grease in the boiler, by preventing the proper transmission of heat.

Mr. Milton's paper followed. Its object was to show that when a cylindrical boiler of the return tube type is subjected to pressure the staying of the combustion chambers to the shell has an effect of distorting the shell, dragging it out of the cylindrical form, thus the flat surfaces of the combustion chambers tend to bulge inwards on themselves, and away from the shell. This sets up strains which are not equally distributed around the whole circumference of the shell. In order to overcome this, Mr. Milton proposes to stay the combustion chambers with stays radiating from the centre of the shell and distributed all round, so that the stress will be equal on all parts. The author quoted experiments showing that the distortion due to the cause named is far greater than is generally supposed by engineers, in one case amounting to as much as one-eighth of an inch on the diameter. This was at a pressure of 320 lbs. on a boiler 14 feet in diameter having three combustion chambers.

Herr Schlick's paper was of remarkable interest. He has devised an instrument by which a record is obtained, not only of the vertical but of the horizontal vibrations of steamers. Without the aid of illustration it would be impossible for us to describe this very ingenious apparatus. Vibration is an important factor in the design of modern steamers of high speed. Our readers will remember Mr. Yarrow's contributions on this subject, and the very valuable practical results he adduced from the experiments made on torpedo boats. In ocean steamers the question of vibration is now one of great moment. In one well-known Atlantic liner the vibration at one time was a serious objection to the vessel, and the nodal points of vibration were well marked in the length of the vessel, so much so that cabins on these points were greatly preferred, and those who were fortunate enough to be in the confidence of the stewards were able to secure these cabins. It has been shown that the action of the screw itself had very little to do with this vibratory disarrangement, it being the synchronisation of the reciprocating parts of the engine with the natural vibration of the structure of the hull that produces the effect in the most aggravated form.

Mr. Hök's paper on curves of stability is a valuable contribution to the Transactions of the Institution. The author is himself engaged practically in work of the nature which he describes, being a draughtsman in a shipyard on the north-east coast. The Institution can hardly have too many papers from authors of Mr. Hök's position and attainments. We do not propose here to enter into a description of the geometrical principles upon which the author bases his formula, and must refer our readers to the Transactions of the Institution for details. The system claims to give no more than approximation, but it is applicable to all kinds of ships and has the great merit of being readily constructed.

The last evening of the meeting Mr. John Inglis gave some interesting particulars of experiments made with a view to test the desirability of running triple compound engines as two cylinder compounds when low power only is required. The system has been frequently advocated with a view to save coal, but Mr. Inglis's results do not seem to bear out this claim. Two four-hours' trials were made, one with the engine working as an ordinary triple, and the other with the intermediate cylinder thrown out of use. Working triple, the I.H.P. was 810; working two cylinders, 351. In the former case the coal consumed per I.H.P. per hour was 147 pounds. With the intermediate cylinder out of use the coal was 2·238. The consumption of feed water corresponding was 15·25 pounds, and 23·18 pounds per I.H.P. per hour. Of course the comparison must not be taken as indicating degree of the superiority of the triple expansion engines over the ordinary compound, great as that superiority undoubtedly is.

A paper by Mr. Cole on the same subject follows, but the results obtained are not sufficiently conclusive to demand quotation.

The last paper at the meeting was the contribution by Mr. Edwards. Its title sufficiently explains its scope, and it would be quite impossible for us to follow the author's explanation without the aid of the diagrams which he exhibited on the walls of the theatre.

The chief event of the meeting was reserved for the last. It was the presentation of an address to Lord Ravensworth, who for fourteen years has occupied the position of president to the Institution. He now retires, his successor being Lord Brassey. The address referred to the great services that Lord Ravensworth had rendered to the Institution, and the authors of it gave utterance to no conventional platitudes. Lord Ravensworth has worked hard for the Institution of Naval Architects, and has conducted its meetings without favour to any, so that the humblest member could get a hearing equally with the most distinguished. It is not always so in societies of this nature.

A summer meeting of the Institution will be held at Cardiff, a very cordial invitation having been received from the Welsh metropolis. The meeting promises to be of unusual success, judging by the programme which is set forth, and the arrangements made.

THE ACTION OF GLACIERS ON THE LAND

PROF. T. G. BONNEY, F.R.S., read a paper to the last meeting of the Royal Geographical Society on the question, Do glaciers excavate? In view of the correspondence recently published in our columns the arguments adduced in support of the negative conclusions may be cited in some detail.

The question of the glacial origin of lakes involves many separate considerations. While lakes undoubtedly abound in regions now or formerly subjected to glaciation, many of these are formed by the damming of valleys by moraine heaps, or by extensive landslips. The school of Sir A. Ramsay affirm that glaciers are powerful excavating agents, and that there is no other agent but ice competent to form a rock-basin. The last argument breaks down when one considers the number of depressions of all sizes gradually increasing from mere volcanic craters to those of the Jordan Valley and the Caspian Sea, in the formation of which ice could have had no part. The argument that Greenland alone holds the key to the phenomena of glaciation breaks down, for the Alps were once the seat of a vast ice-sheet, which over-rode all the minor inequalities of the surrounding country, and of which the existing glaciers are the shrunken remnant. Thus the Alpine valleys should serve to show the typical results of ice-action on the land. This is the sum of their evidence: toothed prominences have been broken or rubbed away, the rough places have been made smooth, the rugged hill has been reduced to rounded slopes of rock (like the backs of plunging dolphins). But the crag remains a crag, the buttress a buttress, and the hill a hill; the valley also does not alter its leading outlines, the V like section so characteristic of ordinary fluviatile erosion still remains; all that the ice has done has been to act like a gigantic rasp; it has modified, not revolutionised, it has moulded, not regenerated. No sooner do we come to study in detail the effects of the ancient glaciers in the upper valleys of the Alps than we are struck by their apparent inefficiency as erosive agents. Here, where the ice has lingered longest, just beneath the actual glacier we see that a cliff continues to exist. Again and again in a valley we may find that on the lee side of prominences crags still remain, sometimes in sufficient frequency to be marked features in the scenery. The Haslithal is an excellent and representative example. The result of prolonged personal study of the Alps may be summed up in the words—"Valleys appear to be much older than the Ice Age, and to have been but little modified during the period of maximum extension of the glaciers."

The evidence as to the erosive power of glaciers is very slight. Dr. Wright showed that the great Muir Glacier in Alaska covers great stretches of undisturbed gravel in which upright tree-stems remain. Prof. Bonney proceeded to say:—In the Alps about the year 1860 the glaciers began to dwindle. By 1870 considerable tracts of bare rock or debris were exposed, which a dozen years before had been buried under the ice. On none of these have I seen any basin-like hollow or sign of excavation as distinguished from abrasion. The Unter Grindelwald Glacier in the last stage of its descent passes over three or four rocky terraces. The angles of these are not very seriously worn away, nor are hollows excavated at the base of the steps. The bed of the Argentière Glacier (I made my way some little distance under the ice) was rather unequal, and was less uniformly abraded than I had expected. There were no signs whatever of the glacier being able to break off or root up blocks of the subjacent schistose rock: it seemed simply to wear away prominences. This also is true of other glaciers. Prior to 1860, and again in 1891, I saw glaciers which were advancing. They ploughed up the turf of a meadow for a foot or two in depth; they pushed moraine-stuff in front of them, showing some tendency to over-ride it, and nothing more. In 1875, at the foot both of the Glacier des Bois and of the Argentière Glacier, was a stony plain. Both these proved to have been recently uncovered by the ice; in other words, the glacier had not been able to plough up a boulder-bed even at a place where, owing to the change of level, some erosive action not unreasonably might have been expected. But, further, on both these plains big blocks of protogine were lying which were striated on sides and top, thus showing that the ice had actually flowed over them, as if it were a stream of mud. Some of the difficulties in the way of believing in the scooping out of lake-basins have now to be considered.

First, in regard to their position: some of them, such as Constance, Geneva, Como, Maggiore, &c., are comparatively near to the lower limits of the great ice sheets, and so would be covered for a relatively short time. All of them are many miles from the ends of the existing glaciers, yet we are asked to admit that a rock basin, in depth sometimes exceeding 1000 feet and generally more than 500, has been scooped out in a time much shorter than that which has proved insufficient for the obliteration of the original features of the upper valleys or for the deepening of their beds by more than a few yards at most—indeed, as a rule, the ice seems never to have been able to overtake the torrent.

The radiating arms of the Lakes of Lucerne, Lugano, and Como are insuperable difficulties in the way of accepting a glacial theory of the origin of these lakes, and the configuration of the Lake of Geneva and the other lakes in France recently minutely surveyed, lends no countenance to the theory of excavation.

One fact to which Prof. J. Geikie has called attention seems at first sight strongly to support Sir A. Ramsay's hypothesis, and is the only real addition, in my opinion, which has been made to the original reasons. It is that many of the Scottish lochs are true rock basins, and that similar basins frequently occur outside their mouths. This also often holds of the fjords in Norway, New Zealand, and elsewhere. Prof. Geikie points out that several of these basins occur just when the ice might be expected to obtain an increased scooping power. His map at first sight appears very convincing; but a study of the larger charts reveals many anomalies. Loch Linnhe, for example, from below the entry of Loch Leven, maintains a general depth of from 34 to 50 fathoms; then, below Loch Corrie, a channel may be traced which varies in depth from 50 to 60 fathoms, after which, in the Lynn of Morven, we find it deepen to 70 fathoms, then to 90 fathoms; and at last, a little north-east of the line joining Barony Point with Lismore Point, it expands into a basin with a maximum depth of 110 fathoms. But outside, in the Sound of Mull (to the north-west) the depths become very irregular, varying from about 35 to 70 fathoms. Barony Point appears to be connected with Mull by a submerged isthmus, generally less than 20 fathoms below the surface. But here, if the glacier were stopped by impinging on Mull, it ought in splitting to be pushing hard upon its bed. In all this region the irregularities of the bed are very perplexing, whatever hypothesis be adopted; but I will restrict myself to a single instance. Off the west coast of Scarba, under the lee of the "Islands of the Sea," and where the opening towards Colonsay makes it improbable that the ice can have forced into a narrower space, an elongated basin occurs in which the soundings—outside about 60 fathoms—deepen to 100, and at one place to 137 fathoms. The sea-bed about Arran presents similar difficulties. In short, here, at Loch Etive, Loch Lomond, and in other places, all goes well only so long as we restrict ourselves to generalities and abstain from details.

The theory of the origin of rock-basins, which I brought forward full twenty years ago, is now supported by much additional evidence. It is that the lake beds are ordinary valleys of sub-aerial erosion, affected by differential earth-movements. This has been very strongly confirmed by the surveys of the old beaches of the great lakes of North America, the Iroquois beach being full 600 feet higher at the north-eastern part than it is at the western end of Lake Ontario.

To conclude, glaciers, when the paths which they have traversed are carefully studied, appear to have acted, as a rule, as agents of the abrasion rather than of erosion. Even in the former capacity they have generally failed to obliterate the more marked pre-existent features due to ordinary fluviatile and sub-aerial sculpture. In the latter capacity they seem to have been impotent, except under very special circumstances; thus, while we may venture to ascribe to glaciers certain shallow tarns and rock basins in situations exceptionally favourable, we cannot assign to their agency either the greater Alpine lakes or any other important lakes in regions which were overflowed by the ice only during the period when it attained to an abnormal development. In the discussion which followed the paper, Dr. Blanford, Sir Henry Howorth, Mr. Freshfield, and Mr. Conway took part.

FURTHER STUDIES ON HYDRAZINE.

A FURTHER contribution to the chemistry of hydrazine, N_2H_4, is communicated by Prof. Curtius to the current number of the *Berichte*. The first portion of the memoir deals with the preparation and properties of substituted hydrazines containing the radicles of the organic acids. In the latter portion a number of inorganic salts containing hydrazine are described.

When hydrazine hydrate is brought in contact with the amides,

chlorides, or esters of the organic acids, primary acid hydrazines are produced, of the general structure $R.CO.NH.NH_2$, where R represents the hydrocarbon radical contained in the acid Ammonia, hydrochloric acid, or alcohol is simultaneously formed, according as an amide, a chloride, or an ester is employed. The reactions proceed with facility and regularity, frequently in the cold, and afford theoretical yields of the substituted hydrazines. For many reasons, however, the esters are most convenient for the preparation of these acid hydrazines upon a large scale.

The primary acid hydrazines are colourless, non-volatile solids which usually crystallise well. The first member of the series, formyl hydrazine, $H.CO.NH.NH_2$, melts at 54°. They are usually soluble in water and alcohol, but insoluble in ether. Most of them form stable salts with one molecule of hydrochloric acid. The hydrogen of the imido group NH is replaceable by metallic sodium or by the radical acetyl. They possess reducing properties similar to those of phenyl-hydrazine, and they condense readily with aldehydes and ketones to form insoluble tertiary hydrazines. Upon heating, frequently by simply boiling their aqueous solutions, they become converted into secondary symmetrical hydrazines in accordance with the equation : $2R.CO.NH.NH_2 = R.CO.NH.NH.CO.R + N_2H_4$. The liberated hydrazine decomposes into ammonia and free nitrogen.

The secondary symmetrical acid hydrazines are very stable substances, soluble only to a slight extent in water. They are usually colourless, possess high melting points, and behave as acids. By the action of powerful oxidising agents they are converted into substances endowed with brilliant colours, ranging from yellow to bright red, which appear to be of the nature of "azo" compounds.

Of particular interest is the substituted hydrazine obtained by the action of hydrazine hydrate upon urea, the amide of carbonic acid. When urea is boiled with hydrazine hydrate a monohydrazide is first produced, $NH_2.CO.NH.NH_2$. This substance, however, is unstable and passes spontaneously into the secondary symmetrical compound $NH_2.CO.NH.NH.CO.NH_2$ with elimination of hydrazine, N_2H_4. This secondary hydrazide is identical with a compound of the same constitution previously obtained in an entirely different manner by Thiele.

An extremely interesting reaction occurs when the acidyl hydrazines of monobasic acids are treated with nitrous acid. They are directly converted into esters of azoimide, N_3H, in accordance with the following equation :—

$$R.CO.NH.NH_2 + NO.OH = R.CO.N_3 + 2H_2O.$$

During the course of work upon this latter reaction it was observed that the organic azoimides, both those containing acid and those containing hydrocarbon radicles, $R.CO.N_3$ and RN_3, behave in a peculiar manner with water. Thus diazobenzene-imide $C_6H_5.N_3$ resinises with a copious evolution of gas ; similarly benzoylazoimide, $C_6H_5.CO.N_3$, when boiled for some time in contact with water evolves large quantities of nitrogen and carbon dioxide, and becomes converted into a magnificently crystallising base of the composition of a symmetrical diamidobenzophenone, $C_6H_4.NH_2.CO.NH_2.C_6H_4$.

The hydrazines of dibasic acids do not yield derivatives of azoimide, but break up with a violent evolution of nitrogen and formation of secondary symmetrical hydrazines. For instance the hydrazine of oxalic acid yields the symmetrical compound

$$\begin{array}{l} CO.NH.NH.CO \\ \quad\quad\quad\quad\quad | \\ CO.NH.NH.CO \end{array}$$

Several of the hydrazines of unsaturated acids behave in a manner peculiar to themselves. Thus the hydrazine derived from fumaric acid, $C_2H_2(CO.NH.NH_2)_2$, yields with nitrous acid an extremely explosive colourless compound, of the nature of a diazofumaramide, $C_2H_2(CO.NH.N_2.OH)_2$.

Prof. Curtius has succeeded in preparing a large number of double salts of metallic sulphates and chlorides with hydrazine sulphate and chloride. The double sulphates are constituted according to the general formula $(N_2H_4)_2H_2SO_4.R''SO_4$, and are distinguished by their difficult solubility and by the absence of water of crystallisation. Salts of the series have been prepared containing as the metal R'' copper, nickel, cobalt, iron, manganese, zinc, and cadmium ; magnesium does not appear capable of forming a double sulphate. The blue copper salt is only soluble to the extent of one part in 1150 parts of water at 10°. It dissolves in ammonia with evolution of nitrogen.

The double chlorides are constituted according to the general formula $N_2H_4.HCl.RCl$. They are readily soluble in water, and certain of them may also be recrystallised from alcohol. Some contain water of crystallisation, while others are anhydrous and exhibit sharp melting points.

Hydrazine likewise forms a double phosphate with magnesium, which closely resembles ammonium magnesium phosphate.

Hydrazine appears to be remarkably stable towards nitric acid, but Prof. Curtius has eventually obtained the nitrate, $N_2H_4.HNO_3$, in splendid crystals which melt at 70°. If these crystals are heated suddenly they explode with great violence. The acid salt, $N_2H_4.2HNO_3$, loses nitric acid when its solution is evaporated. It may be remembered that Prof. Curtius observed a similar greater stability of the monacid salt in the case of the chlorides, for upon heating the dihydrochloride, $N_2H_4.2HCl$, to 140°, it was found to be completely converted into the monohydrochloride, $N_2H_4.HCl$.

A. E. TUTTON.

THE INTERNATIONAL CONGRESS OF PREHISTORIC ARCHÆOLOGY AND ANTHROPOLOGY.

IT is probably unique in the history of congresses that a report of the proceedings should be published within a period of three months from the time of the meeting. Such a feat was accomplished by the publication committee of the International Congress of Prehistoric Archæology and Anthropology, the eleventh session of which was held some time ago at Moscow. All the communications are printed in French. The first volume of the Report is divided into five sections ; of these the first is devoted to geology and palæontology in their relations to primitive man. In his paper upon the constitution of the quaternary deposits in Russia and their relations to the finds resulting from the activity of prehistoric man, S. Nikitine draws the following conclusions :—The subdivision of the stone age into palæolithic and neolithic epochs should be retained for Russia in Europe, because it coincides with the geological subdivisions pleistocene and recent, which in their turn are based upon palæontological facts. The study of the glacial deposits of Finland and of the western region do not furnish any proof of the existence of two special glacial epochs and of an interglacial epoch ; all the facts can be explained by phenomena of the oscillation of a glacier at the time of its gradual but irregular retreat. The time corresponding to the inter-glacial epoch and that of the second glaciation of the Swedes was probably for the greater part of Russia the period of the formation of ancient lacustrine deposits, of the loess and of the upper fluviatile terraces, containing the bones of the mammoth and other extinct mammals. Man lived simultaneously with the mammoth during the second half of the glacial epoch along the limit of glaciation, knowing amongst other things the use of fire, but only making splintered flint implements. As the glacier retreated man advanced towards the north and north-west ; he arrived in Finland and in the Baltic region after the close of the glaciation, and after the disappearance of the mammoth ; but man then possessed the more advanced culture of the neolithic period, and besides chipped flint implements he knew how to make implements of polished stone, pottery, &c. Russia in Europe does not present any traces of man in the first half of the pleistocene or of still more ancient man.—Prof. W. W. Dokoutchaïev contributes a valuable essay on the Russian steppes, past and present, in which he deals with the last page of Russian geology, and comes to the conclusion that before the glacial period the difference between the relative altitudes of the north-west and of the centre of Russia were much more considerable than at present. The author describes the carving of the steppes and their surface drainage ; their soil, and that of the forests ; the vegetation, fauna, and climate of the

steppes. As the soil of the forests differs in character from that of the tchernozème the author and M. Gheorgievsky were able to prove the greater extent formerly of the Poltava forests.—The second section deals with prehistoric archæology. In a paper entitled comparison of the primitive industries of France and Asia, G. Chauvet discusses the question "Can one establish general divisions, applicable to both Western Europe and Asia, for prehistoric times and especially for the palæolithic period?" The general progress of the industrial arts has been the same in Asia and in Europe during prehistoric times, but how far these epochs were synchronous is unknown. In order to have terms for comparison it is necessary to have a "fixed base"; such a base is afforded by the glacial phenomena. He concludes by urging that the great engineering works which are now progressing in Asia afford opportunities for obtaining information on these problems which should not be neglected.—Lubor Niederle (of Prague) calls attention to the latest results of prehistoric archæology in Bohemia, and its relations with Eastern Europe, and arrives at the conclusion that the Slavs arrived in Bohemia earlier than is admitted by historians. He believes that the Slavs, like the Germans and Gauls, were originally dolichocephalic, and of a blonde complexion.—The other papers in this section are short, two of them being on nephrite.—The third section is confined to tumuli and encampments (*Kourganes et goroditchtschés*).—A. Spitzine reports on the bone-encampments in the north of Russia.—P. Krotov comes to the following conclusions in his paper on the layers of stone implements in the district of Iaransk, government of Viatka; the stone implements of the district of Iaransk do not belong to the true stone age, but to the epoch of the encampments and other ancient dwellings of the Finns, who made use of implements of stone and bone, along with utensils in iron and bronze. During this period of the life of the Finns, elements of a more advanced civilization penetrated into their country, coming from the centres of civilization of eastern Russia; flint and bone implements being replaced by iron tools.—B. Pérédolsky has a paper on the "jalnik" (necropolis) of Iuriévo, in the district of Borowitchi, government of Novgorod."—The first paper in the Anthropological Section is by Topinard on race in anthropology, in which he asserts, (1) On no part of the surface of the globe can one discover a population entirely free from mixture, and presenting only a single type; (2) that the anthropological materials on which we work, and from which we extract the double notion of the type to begin with, and of its continuity in time, are only peoples; (3) that if the first factor, the type, is accessible with labour, the second, its permanence in time, is only a conjecture which it is impossible to demonstrate; (4) that in consequence the notion of race in the two factors, and especially in the latter, is only a subjective notion, a mental conception, peoples and their historic elements being the only objective realities. Later on he says: "In order to show how in Europe, for example, the question of nationalities is foreign to that of races, or even of the constituent elements of peoples, one need but remember that three or four races (using the word conditionally) only are fundamentally concerned in the formation of the numerous peoples which at the present time are distributed from north to south, and from east to west. The races are the whites, the brachycephals, and the browns. They are found everywhere, with only here and there some secondary additions. Their proportions alone vary. To the north there are more blondes; in the centre, from the Urals to Portugal, the brachycephals dominate; to the south, around the Mediterranean, the browns are in the majority. If two peoples agree in certain characters it does not follow that they have the same nationality. Kollmann, in an illustrated paper on the human races of Europe and the Aryan question, argues that it is necessary to distinguish at least four different types in Europe (the *Dolichocephalic leptoprosopes* and *chamæprosopes* and the *Brachycephalic leptoprosopes* and *chamæprosopes*) which have continued, without any doubt, since the neolithic period; that the intellectual European culture is a common product of these types.—In his paper on the weight of the brain among several peoples of the Caucasus, Dr. N. Giltchenko gives valuable data on fifty-seven subjects. Anoutchine has a paper entitled, "On Ancient, Artificially Deformed Skulls found in Russia."—The last section is devoted to Prehistoric Ethnography. In his contributions to the prehistoric ethnography of Central and North-East Russia, J. Smirnov concludes that the linguistic facts permit the supposition that only a part of the remains of the neolithic period of Central Russia can belong to the Finns. The antiquity of sepultures can be determined, besides other ways, by the animal bones deposited with the dead. The N.-S. position of the skeleton may be regarded in Central Russia as one of the indices of ancient Finnish sepultures. To the category of the monuments of prehistoric epochs belong geographical names. The place-names of northern and central Russia prove that its pre- or proto-historic population has been more homogeneous to the east, in the region of the Permiens and Ougriens, and more mixed to the west.—N. Troïtzky has a very interesting paper on vestiges of paganism in the region situated between the upper courses of the Oka and of the Don. Fire, tree, and stone cults persist, but modified by Christianity.—E. Chantre has a project for reform in the nomenclature of the peoples of Asia"; and A. Ivanovsky, some information upon the questions: (1) of the simultaneous employment of sepulture and incineration; and (2) of the stone statues called "Kamennya baby."—The last is the most important communication, "Which is the most ancient race in Russia?" by Prof. A. Bogdanov, of Moscow. He finds that the most ancient skulls are dolichocephalic. In passing to the more modern tombs since the fifteenth century, we see a diminution of the quantity of dolichocephals and the preponderance of brachycephals. In the ancient tombs of the government of St. Petersburg, as well as in some districts of Novgorod, we meet from the stone age onwards skulls of a type quite distinct from those characteristic of the tumuli (*kourganes*) of Central Russia. From Moscow eastward, and as far as the Urals and Siberia (Tobolsk), we find the tumuli of the brachycephals. In the governments of Moscow, Smolensk, Riasan, and Don, we have only in some localities the series of the dolichocephals, and in others a kind of mixture of characters; in these localities, more than in the others, mixture was possible, since they are found either on the great routes of migrations, or at the limit of the distribution of different races. In the tombs called "Scythian" the majority of the skulls quite resemble the dolichocephalic tumuli-population of Central Russia. One finds only occasionally Mongoloid skulls in the tumuli of Central Russia, and in the tombs of Southern Russia; whilst in the tumuli of Tobolsk, and of the Uralian countries they abound and often predominate. The territory of this dolichocephalic leptoprosopic primitive people is very distinctly limited to the north, east, and south by the tumuli, with a population quite brachycephalic, or presenting this type in preponderance. There is no south-west limit. In Galicia, north and south Germany, and Sweden we meet with the same type in the ancient tombs as in those of Central and Southern Russia. There are true primitive dolichocephalic chamæprosops in Asia among the Mongolians, but not in Europe. Kollmann's European types appear to be the result of mixture with brachycephals, or of what Virchow calls "pathological races." Dolichocephalism is more and more diminishing in Europe. The larger and broader heads of the civilized classes should be attributed to other causes than merely to mixture.

A. C. H.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science for January, 1893, contains:—On the relationships and *rôle* of the Archoplasm during mitosis in the larval salamander, by John E. S. Moore (plate xxi.).—On the occurrence of embryonic fission in cyclostomatous polyzoa, by Sidney F. Harmer (plates xxii.-xxiv.). The extraordinary phenomena described in detail in this paper were announced in brief to the Cambridge Philosophical Society a couple of years ago. The completed investigations of the author indicate in the clearest way that the young larvæ of *Crisia ramosa* are produced as buds from an embryonic mass of cells found in the young ovicell. "At the end of segmentation the embryo consists of a small mass of undifferentiated cells, lying near the distal end of the follicle, which has increased largely in size, and now forms a spherical knob projecting freely into the interior of a spacious tentacle sheath;" after a time "the embryo, although remaining a solid mass

without differentiation of organs, grows out into several finger-shaped processes, which are generally directed towards the distal end of the ovicell" . . . "these finger-shaped processes are divided up by a series of transverse constrictions into rounded masses of cells, each of which becomes a complete larva;" the few rare cases in the Tunicates and Cœlenterata, where the asexual reproduction of buds takes place from very feebly developed embryo forms are cited.—On two new genera and some new species of earthworms, by Frank E. Beddard, F.R.S. (plates xxv. and xxvi.). Describes *Trichochæta hesperidum*, nov. gen. et spec. from Jamaica; *Alvania millsoni*, nov. gen. et spec. from Lagos; *Polytoreutus magilensis*, n. sp. from Magila, East Central Africa; and *Pygmæodrilus lacuum*, n. sp. from Lagos. There are also notes on *Siphonogaster millsoni*, F.E.B.—Observations on the gregarines of Holothurians, by E. A. Minchin, B.A. (plates xxvii. and xxviii.). These gregarines apparently first indicated by Kölliker, and identified by Schneider (1858), have since been studied by Cuénot, Mingazzini, Ludwig and Léger, and have now been closely investigated from fresh material found at Naples and Plymouth, by the author. *Gregarina irregularis*, n. sp. found on the blood vessels of Holothuria, at Plymouth, is described; numerous details about the spores and sporozoites are given, and the difficult question of the affinities of these forms is discussed.—A new Sporozoon in Amphioxus, by E C. Pollard (plate xxix.). These minute parasites were discovered in the epithelium of the intestine. Miss Pollard also figures a ciliate Protozoan found in the atrium of Amphioxus, which had been found some time back by Prof. Ray Lankester, he suggests that possibly the Sporozoon may be a stage in the life history of the ciliate form.—Studies on the Protochordata, by Arthur Willey. I. On the origin of the branchial stigmata, præoral lobe, endostyle, atrial cavities, &c., in *Ciona intestinalis*, Linn., with remarks on *Clavelina lepadiformis* (plates xxx. and xxxi.). As the result of prolonged and very complete investigations, the author finds himself compelled to completely alter his previously published views as to the homologies existing between the various organs of the Ascidians and Amphioxus.

Wiedemann's Annalen der Physik und Chemie, No. 3, 1893.—Electromagnetic theory of colour dispersion, by H. von Helmholtz. A mathematical deduction of Fresnel's and Cauchy's formulæ from the electromagnetic theory of light by means of an application of the principle of least action to electrodynamics.—Magnetisation of a radially slit iron ring, by Heinrich Lehmann. The method employed was practically that of Ewing, with ballistic measurement. The normal curve for the closed ring was first determined. The ring was then slit radially, and the width of the slit regulated by plane parallel discs of brass introduced between the faces, the ring being tightened by a brass collar whenever necessary. To measure the flow of induction through the slit, the brass disc was wound with a number of turns of very fine copper wire. The width of the slit was varied from 0·4 mm. to 3·57 mm., and the strength of the magnetic field from 1 to about 300. It was found that the coefficient of dispersion, *i.e.* the ratio of the mean induction to that at the slit, increased with the width of the slit and finally decreased with increasing field intensity. The divergence of lines of force was practically limited to the neighbourhood of the slit. For each width of slit the coefficient of demagnetisation was constant up to about half saturation point. A formula is given for calculating this coefficient from the geometrical dimensions of the system.—On the influence of temperature upon circular ferro-magnetic polarisation, by Emil Hirsch. Transparent plates of iron, nickel and cobalt were prepared by electro deposition upon a transparent film of platinum burnt into a glass plate 2 mm. thick and free from double refraction. Lippich's half-shadow polarimeter was used for measuring the circular polarisation. The light was furnished by a zirkonium burner, and the magnetic field by a large electromagnet fed with a current of 33 amperes giving a field of 9000 C.G.S. units. The metallic films were enclosed in a brass box heated by two Bunsens, the temperatures being measured by thermometers and an iron-german-silver-thermopile. As a result, Kundt's constant, or the ratio of the rotation of the plane of polarisation to the increase of "magnetisation potential" from one side of the film to the other, was found to be independent of the temperature within the limits of observational error.—Also papers by E. Lommel, F. Richarz, K. Ångström, H. Ruoss, P. Drude, and H. E. J. G. du Bois.

Bulletin de l'Académie Royale de Belgique, No. 2, 1893.—We notice the following papers:—On a new form of blende, by G. Cesáro. The specimen occurred in the granular dolomite of Binnen, in the form of a light yellow translucent crystal 3 mm. in diameter. Its crystalline form is that of the tetrahexahedron, the trihedral angles being truncated by striated scalene triangles.—A new electrical process permitting the production of temperatures superior to those actually realisable, by Eug. Lagrange and P. Hoho. The new method consists in the passage of a current through a conducting liquid by means of electrodes, one of which is made of the substance to be raised by a high temperature. M. Violle has recently estimated the temperature of the electric arc at 3500° C. and found that it is constant, so that it represents the highest temperature attainable by that method. In the new method the heat is developed at the surface of the electrode. During the passage of a current of, say, 2000 volts and 150 amperes through a 10 per cent. solution of sulphuric acid, a layer of gas is formed round an electrode consisting of a plate of graphite, and since the resistance of the circuit is concentrated in this layer of gas, practically the whole energy of the current is transformed into heat in the immediate vicinity of the substance to be operated upon. The temperature rises until the amount of heat, dissipated by conduction and radiation, is equal to that produced. If the production of heat is very rapid, this limit will be very high, and the temperature obtainable depends simply upon the strength of the available current.

Annalen des K. K. Naturhistorischen Hofmuseums. Bd. vii. (Wien, 1892).—The last two parts (Nos. 3 and 4) of the seventh volume of the Annals of the Royal Natural History Museum of Vienna fully maintain the credit of this publication.—In his Contributions to the knowledge of the Crustacea of the Canary Islands, K. Koelbel describes and figures *Livoneca sulcata*, n.sp. and *Munidopsis polymorpha*, n.sp.—The species of *Alectoria* and their geographical distribution, by Dr. E. Stizenberger.—A contribution to the morphology of Corundum, by Dr. H. Barvír. Two twin sapphires are described and figured.—In Part II. of his "Meteoric Studies" E. Cohen gives analyses of twelve American meteorites.—Two plates illustrate F. Siebenrock's paper on the skulls of the Scincoidæ, Anguidæ, and Gerrhosauridæ, twenty-six species of the first and three each of the second and last are referred to.—New forms of Hymenoptera, by F. F. Kohl (three plates), thirty-eight new species are described and one new genus *Heliocausus*.—On the typical specimens of *Lacerta mosorensis*, Kolomb. (1886) (= *Lacerta koritana*, Tom. 1889) by Dr. F. Steindachner (pl. xvi.).—Contributions to the Microlepidopteran fauna of the Canary Archipelago, by Dr. H. Rebel (pl. xvii.). Ten new species and two varieties are described and figured, and one new genus, *Hypotomorpha*. The paper concludes with a valuable index and table of the geographical distribution of sixty-three Microlepidoptera; the distribution includes west and east Canary Islands, Azores and Madeira, N.W. Africa, Mediterranean region, and other regions.—Part IV. contains the following papers:—Remarks upon the species of the genus Potamogeton in the Herbarium of the Royal Natural History Museum, by A. Bennett; three new species are described.—Compositæ Hildebrandtianæ et Humblotianæ in Madagascaria et insulas Comoras collectæ, by Dr. F. W. Klatt (six new species).—Lichenes exotici Herbarii Vindobonensis, by Dr. J. Müller.—The birds of Austro-Hungary and of the land of occupation in the Royal Natural History Museum of Vienna, by Dr. L. R. L. v. Liburnau.—On vertebral assimilation among the Lizards, by F. Siebenrock. Normally but two sacral vertebræ support the pelvis in lizards, but in 1864 Hyrtl described under the term "Wirbelassimilation" deviations from this rule. In this paper several examples are given in which the last lumbar or the first caudal vertebra is connected with the pelvis; a figure is given of the latter arrangement in a specimen of *Uromastix spinipes*, and of the former in a specimen of *Lacerta Simonyi*. The last paper—Old Mexican relics from the Castle Ambras in the Tyrol, by F. Heger—is of ethnological interest. Four photographic plates, and one in colours, illustrate this paper, and, like the majority of the illustrations of this journal, are of the highest excellence.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, March 9.—Mr. A. B. Basset, F.R.S., Vice-President, in the chair.—Mr. T. J. Dewar exhibited, with the aid of a stereoscope, twenty stereographs of the regular solids. These were not photographs of a solid object from two points of view for binocular vision, but the same object was drawn twice over by Mr. Dewar in perspective with different station points. The relief was aided by making the lines in the foreground thick, and those behind thin.—Mr. Love read a note on the stability of a thin rod loaded vertically. Suppose a thin rod or column is held vertically at its lower extremity, and loaded at its upper extremity. It is well known that, unless the load exceeds a certain limit, the rod will be simply compressed longitudinally without being bent. If, however, the limit is exceeded there exists a curved form in which the rod can be held by the application of the given load. This form must belong to the *elastica* family of curves. Now when the length and the load are given the elastica is not entirely determinate. In fact for the same length and the same load (if sufficiently great) there exist forms having respectively 1, 2, 3. . . . inflexions. These are the curves figured in Thomson and Tait's "Nat. Phil.," part ii. p. 148, and for our present application the rod must be supposed held at the middle point of one of the bays, into which it is divided by the line of action of the load. Thus the part of the curve between the point of support and the nearest inflexion is half a bay, the rest of the curve up to the point of attachment of the load consists of an integral number of complete bays. Now although all these forms are possible there is only one which is stable, and that is the form with a single inflexion. To prove this we have to investigate the potential energy in the configuration with a single inflexion, in which the curve forms a single half bay, and in the configuration with $2n+1$ inflexions, in which the curve forms $n+\frac{1}{2}$ bays. It is not difficult to prove that in every case the latter potential energy is the greater. It follows that the figures given by Euler's "Theory of Struts" in which the rod forms a curve which is nearly a curve of sines of small amplitude crossing the line of action of the load more than once are all unstable forms. The stable form is a curve of finite curvature, which never crosses the line of action of the load. —Prof. Lloyd Tanner next made a communication on complex primes formed with the fifth roots of unity. The object of the paper is to explain a method of calculating the complex prime factors of real primes included in the form $10\mu+1$. The only published method which I have met with is due to Kummer. This is not restricted to the particular case here considered; but as it involves the determination of the G.C.M. of two complex numbers, it is probably more laborious than the method now communicated. The method adopted by Reuschle in the calculation of his tables does not appear to have been published. The process here is based on the indeterminate equation

$$X^2 - 5Y^2 = 4p.$$

A minimum solution of this equation gives the "simplest" prime factor according to Kummer's definition (*Berlin Monatsberichte*, 1870, p. 413) and solutions in which Y is a multiple of 5 give the "primary" prime factors which Kummer found it necessary to use in order to establish the general law of reciprocity. In solving the equation Lagrange's method turns out to be impracticable, and a short discussion—treated graphically—is introduced, which is sufficient to show the relations between the different solutions. These relations can be expressed in the form—

$$\begin{pmatrix} 2, & 0 \\ 0, & 2 \end{pmatrix}\begin{pmatrix} X, \\ Y \end{pmatrix} = \begin{pmatrix} a, & 5b \\ b, & a \end{pmatrix}\begin{pmatrix} X', \\ Y' \end{pmatrix}$$

and it is interesting to note the intimate connection between these matrices and the complex units. From any solution (X, Y) three numbers A_0, A_1, A_2, are found, A_0 being the integer next greater than $2X/5$, and these serve to determine the values and sequence of the co-ordinates a_0, a_1, &c., in the required prime factor

$$a_0 + a_1\omega + a_2\omega^2 + a_3\omega^3 + a_4\omega^4.$$

The first condition is

$$A_0 = a_0^2 + a_1^2 + a_2^2 + a_3^2 + a_4^2.$$

The values of a have to satisfy other conditions, some of which are tested by mere inspection. To give some idea of the facility of the method from the calculator's point of view it may be stated that the determination of the prime factors of two primes selected at random in the second million (viz. 1,562,051 and 1,671,781) was completed in three hours. The only auxiliary table required is a table of squares: and if this extends to the square of 7000 it will suffice for the factorisation of all primes in the first nine millions. Tables are appended giving the simplest —and simplest primary—prime factors of all suitable primes less than 10,000. The reciprocal factors are also given after the first thousand. For the first thousand the reciprocal factors have already been published; and instead of giving these again, a comparison is indicated between the factors here given and those published in Reuschle's tables. The result of the comparison suggests that Reuschle's method of calculation was not the same as that now communicated.—The dioptrics of gratings, by Dr. J. Larmor, F.R.S. When a beam of light falls on a continuously ruled or striated surface, in addition to the principal portion that passes on and the portion that is scattered and lost by the roughnesses of the surface, there are formed a series of secondary diffracted beams that are propagated onward in oblique directions. Each of these beams is produced in the well-known manner by the union of the elements from the different striations (or homologous groups of striations), which arrive at its front in a common phase. The dioptrical discussion of such diffracted beams, that is so far as regards their geometrical properties, forms a rather simple case of the theory of the refraction of a general dioptrical pencil, which has been developed by Hamilton, Maxwell, and other writers. In the case of homogeneous wave-length λ, when the principal beam, coming from its focal lines, is refracted at the striated surface to two other focal lines, the nth diffracted beam is propagated as if it were simply refracted at a new surface formed by adding on at each point a thickness $(\mu - 1)nm\lambda$ of the refracting medium in front of the original surface; where m is the number of striations counting from any arbitrary origin on the surface up to the point. The case of reflexion is included by making $\mu = -1$. As a special example, it is well known that the positions of the primary and secondary foci for conical pencils in a spherical Rowland grating, are determined by the same formulæ as hold for reflexion in a curved mirror. The treatment of the aberration at the focal lines, or the discussion of the caustic surfaces of the diffracted beams, is reduced immediately to the Hamiltonian formulæ by noting that the characteristic function of the beam is increased by the quantity $(\mu - 1)nm\lambda$, exactly, in crossing the diffracting surface.—The secretary read a brief abstract of a note by Prof. L. J. Rogers on a three-fold symmetry in the elements of Heine's series.—Messrs. Greenhill, Walker, Cunningham, and the Chairman joined in the discussions on the papers.

Royal Microscopical Society, March 15.—A. D. Michael, President, in the chair.—The president said that a series of thirty-six photomicrographs had been sent to the Society of Arts, in compliance with the request read at the last meeting, for exhibition at Chicago.—An electric turntable was exhibited on behalf of Mr. Payne, of Newcastle. It consisted of a brass turntable of ordinary pattern having an electric motor fitted beneath the plate; the whole was caused to revolve by the current from a bichromate battery cell.—Dr. W. H. Dallinger gave a brief description of Prof. Bütschli's experiments on the so-called artificial protoplasm; and said in conclusion, that he could not suppose that any one looking at these forms would regard them as in any way allied to living matter. The more intimately they became acquainted with them the more sure they would become that they were only forms, and that those which appeared under a low power to be so much like tissue were under a high power seen to be minute bubbles and nothing more. He believed the movements observed would be found to be due to the effect of differences of surface tension, and that the study of them would no doubt help them to understand some of the mechanical properties of protoplasm, but they did not leave an impression that they had caused an approximation in the least degree towards the artificial production of protoplasm.—Mr. R. T. Lewis exhibited and described a new species of Aleurodes (*A. asparagi*) which had been found upon the leaves of asparagus in Natal.—Mr. T. F. Smith read a note on the use of monochromatic yellow light in photomicrography. —Prof. F. Jeffrey Bell read a note from Dr. A. M. Edwards on

a simple mode of illumination for the microscope.—Surgeon V. Gunson Thorpe's paper on the rotifera of China was read by Prof. Bell.—Dr. G. M. Giles's paper on certain cystic worms which simulate the appearances of tuberculosis was also read by Prof. Bell.—Dr. R. G. Hebb said that he had never met with any of the worms described in England. He had found nodules in the lungs of sheep, and although unable to find the worm, he had supposed it to be the cause of what he had found. —Prof. Bell thought that what Dr. Giles stated in the beginning of his paper was of considerable importance, because if the large number of animals which were killed as being tuberculous were really not so, it might be possible to prevent their destruction. There was, he imagined, a general dislike amongst most persons—except such as were fond of high game—to eating meat which swarmed with parasites of any kind; for if it was correct that the cattle in India which were reputed to be highly tuberculous were not so, it was very important that the fact should be widely made known.—The president said that he fully agreed with Prof. Bell in his remarks.—Dr. A. C. Stokes's paper on new brackish water infusoria from the United States was taken as read.

Linnean Society, March 16.—Prof. Stewart, President, in the chair.—A curious freshwater alga, growing in a perfectly spherical mass without any visible point of attachment, and described as a condition of *Cladophora*, was exhibited by Mr. A. W. Bennett, who stated that specimens had been found in English and Welsh lakes, as well as in Sweden, and that the peculiar spherical form of growth was difficult to explain. Mr. G. R. Murray suggested that it might be due to the action of a current, which would cause a continuous revolution of the mass.—Mr. R. I. Pocock exhibited a singular nest, so called, of a myriopod received from Sierra Leone, and formed of a clayey earth, which had become hardened by exposure. It was suggested that it was not a nest in the proper sense of the word, formed by the creature itself, but rather a case fashioned by ants for the purpose of entombing their enemy.—Mr. G. F. Scott Elliot gave an interesting account of the botanical results of the Sierra Leone Boundary Commission, and of the collections made by him during five months travelling. His remarks were criticised by Messrs. J. G. Baker, C. B. Clarke, W. Carruthers, and Dr. Stapf, who was present as a visitor.—Mr. J. H. Venstone described some points in the anatomy of a mollusk (*Melongona*) from recent dissections made by him, and exhibited several preparations in support of his statements. Prof. G. B. Howes bore testimony to the originality and value of the observations which in some respects were at variance with the views of the most recent writers on the subject. Messrs. G. R. Murray and Horace Monckton offered some remarks on the similarity in certain respects of the fauna and flora of the West Coast of Africa and the East Coast of South America, with reference to the statements made by Mr. Pocock and Mr. Scott Elliot.—The meeting adjourned to April 6.

Anthropological Institute, March 21.—Prof. A. Macalister, F.R.S., President, in the chair.—Dr. Tylor exhibited a collection of the rude stone implements of the Tasmanians, showing them to belong to the palæolithic or unground stage of the implement-maker's art, below that found among prehistoric times in Europe, and being on the whole the lowest known in the world. Fragments or rough flakes of chert or mudstone, never edged by grinding, but only by chipping on one surface with another stone, and grasped in the hand without any handle, served the simple purposes of notching trees for climbing, cutting up game, and scraping spears and clubs. The Tasmanians appear to have kept up this rudimentary art in their remote corner of the world until the present century, and their state of civilisation thus becomes a guide by which to judge of that of the prehistoric drift and cave men, whose life in England and France depended on similar though better implements. The Tasmanians, though perhaps in arts the rudest of savages, were at most only a stage below other savages, and do not disclose any depths of brutality. The usual moral and social rules prevailed among them; their language was efficient and even copious; they had a well-marked religion in which the spirits of ancestors were looked to for help in trouble, and the echo was called the "talking shadow." Such facts make it clear that neither antiquity nor savagery reaches to really primitive stages of human life, which belongs to a remoter past.—A paper by Prof. Politis on burial customs in modern Greece was read; also a paper on the cave paintings of Australia, by the Rev. John Mathew.

EDINBURGH.

Royal Society, February 20.—The Hon. Lord Maclaren, vice-president, in the chair. Mr. Malcolm Laurie read a paper on the anatomy of the *Eurypteridæ*. Cheliceræ exist in front of the mouth in *Slimonia* and *Eurypterus*, thus making the number of cephalothoracic appendages in these forms agree with that of the arachnida in general. The presence of an epiconite on the basal joint of the walking limbs is also an arachnid character. The third to sixth free segments in *Slimonia* carry paired plate-like appendages, each of which appears to have borne one or more branchial lamellæ. There are sternites covering the whole ventral surface of each segment; *Slimonia* differing in this respect from *Eurypterus*, which, according to Schmidt, has no sternites on these segments. The suppression of the sternite of the second free segment and the reduction of its appendage to nothing but branchial lamellæ is due to the enormous development of the genital operculum which covers this region. This suppression of the second segment seems to point to a closer relation of these forms to the *Pedipalpi*, in which the same thing occurs, than to the scorpion, in which the second segment and its appendage are well developed.—The Rev. Prof. Duns discussed the early history of some Scottish mammals and birds.—Prof. Rutherford communicated a paper, by Dr. W. G. Aitchison Robertson, on the digestion of sugar in health.

March 6.—Mr. T. B. Sprague discussed a new algebra, by means of which permutations may be transformed in a variety of ways, and their properties investigated. In this algebra seven symbols of operation are used, the multiplication table being—

	r	i	p	s	t	l	m
r	1	ir	pi	$s^{-1}r$	tr	slr	mr
i	ri	1	pr	si	$t^{-1}i$	li	tmi
p	ip	rp	1	tp	sp	mp	lp
s	rs^{-1}	is	pt	s^2	ts	$s^{-1}ls$	ms
t	rt	it^{-1}	ps	st	t^2	lt	$t^{-1}mt$
l	$s^{-1}rl$	il	pm	s^2l	tl	l^2	ml
m	rm	$t^{-1}im$	pl	sm	t^2m	lm	m^2

Prof. Tait read a note on the compressibility of liquids in connection with their molecular pressure.

March 20.—Dr. D. Gill, H.M. Astronomer at the Cape of Good Hope, communicated a paper illustrated by photographs on recent progress in celestial photography. The method recently used for the determination of the sun's distance by observations of the planet Victoria was also described. A number of separate series of observations have been made—each series by itself being more trustworthy than observations made during a transit of Venus. The results indicate also that the present estimate of the mass of the moon is about one per cent. too large.—A paper was communicated by Dr. Robert Munro on a remarkable glacier lake, formed by a branch of the Hardanger-Jökul, near Eidfiörd, Norway.

PARIS.

Academy of Sciences, March 20.—M. Lœwy in the chair. —On the next solar eclipse, by M. J. Janssen.—On the preparation of a variety of swelling graphite, by M. Henri Moissan. M. Luzi has divided the varieties of graphite into two classes, according to their behaviour on treating with a little nitric acid and calcining. Those which swell up he calls graphites, and those which do not graphitites. The varieties produced ordinarily in the electric arc and by solution in iron do not swell. It can, however, be obtained in the first condition by suddenly cooling the casting in water, when the swelling graphite will be found in the more interior portions. The best way of preparing it is by means of molten platinum. About 200 gr. of platinum are fused in a carbon crucible placed in the elec-

ric furnace. When the metal fu ses it gets saturated with carbon, orming a carburet mixed with free carbon, which after solidification exists in the form of swelling or true graphite. It is separated by aqua regia. The residue consists of slate-grey hexagonal crystals of density 2·06 to 2·08, burning in a current of oxygen at 575°. From 400° upwards it swells like mercury sulpho-cyanide. It is not attacked by fused nitrate of potassium, chromic acid, or hot sulphuric acid, but is rapidly attacked by warm iodic acid and fused sodium carbonate. The swelling up is attributed to the sudden liberation of heated gas due to the decomposition of a very small quantity of graphitic oxide produced under the influence of nitric acid at the expense of a trace of amorphous graphite mixed with the crystallised variety, and more easily attacked than the latter.—Researches on samarium, by M. Lecoq de Boisbaudran.—The pancreas and the nerve centres regulating the glycemic function; experimental demonstrations derived from a comparison of the effects of a removal of the pancreas with those of bulbary section, by MM. A. Chauveau and M. Kaufmann. Medullary section, preceded or followed by bulbary section, produces exactly the same effects as medullary section preceded or followed by the removal of the pancreas. As regards, therefore, the physiological action exerted upon the sugar-forming apparatus, this last operation behaves exactly like the bulbary section. Now the latter determines the super-activity of the liver by suppressing the transmission of the influence of an inhibitory centre situated in the medulla oblongata. As a necessary result, the removal of the pancreas acts in an analogous way in producing hyperglycemia and glycosuria. This operation amounts to the annihilation of the centre controlling the glycogenic function. Hence the pancreas acts upon this function by exciting the activity of this inhibitory centre, and probably also by influencing the exciting centre, which is, on the other hand, checked in its activity by the products of internal pancreatic secretion poured into the blood. The results of the whole experimental investigation on the pathogeny of diabetes are embodied in sixteen propositions.—On the distribution in latitude of the solar phenomena observed at the Royal Observatory of the Roman College during the fourth quarter of 1892, by M. P. Tacchini.—Photography of the solar corona apart from total eclipses, by M. George E. Hale.—On electric waves along fine threads; calculation of the depression, by M. Birkeland.—On initial capacities of polarisation, by M. E. Bouty.—Influence of frequency upon the physiological effects of alternating currents, by M. d'Arsonval.—Measurement of large differences of phase in white light, by M. P. Joubin. A new method of rendering visible the fringes produced by two interfering systems of waves consists in placing an anisotropic compensator upon both the groups which have traversed the interference apparatus. This compensator then receives polarised light which, before being analysed, passes through a plate of quartz with its principal section at an angle of 45° to the plane of polarisation. Such an arrangement has been carried out in one of Fizeau's apparatus for measuring expansions. It reads direct to $\frac{1}{20}$ of a micron.—On spherical aberration of the human eye; measurement of senilism of the crystalline, by M. C. J. A. Leroy. The mean aberration is a function of the age which grows slowly in young people and very rapidly after mature age, tending towards a maximum in old age. The spherical aberration of the eye also depends principally upon the crystalline and notably upon the variability of its index of refraction. In young people this variability is rapid enough to sensibly correct the aberration. It decreases with age, and tends to a limiting value which it would have if the crystalline had a uniform index throughout.—Electrical crucible for the laboratory, with directing magnet, by MM. E. Ducretet and L. Lejeune.—On a phenomenon of dissociation of sodium chloride heated in presence of a wall of porous earth, by M. de Sanderval.—On hydurilic and desoxyamalic acids, by M. C. Matignon.—Action of cotton upon sublimate absorbed in dilute solutions, by M. Léo Vignon.—Influence of the alkalinity of blood upon the process of intra-organic oxidation provoked by spermine, by M. Alexandre Pœhl.—Production of sugar diabetes in the rabbit by the destruction of the pancreas, by M. E. Hédon.—Improvement of potato-culture for industrial and forage purposes in France, by M. Aimé Girard.—On the employment of ruthenium red in vegetable anatomy, by M. Louis Mangin.—Permian fish fauna in France, by M. H. E. Sauvage.—On the manifestation, for more than six hundred years, of sudden variations of temperature on fixed dates during the second fortnight of January, by M. Dom D. Démoulin.—Destruction of trees and public health, by M. J. Jeannel.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Laws and Properties of Matter: R. T. Glazebrook (K. Paul).—British Fungus Flora, vol. 2: G. Massey (Bell).—Text-book of Comparative Geology: Dr. E. Kayser, translated and edited by P. Lake (Sonnenschein). Beiträge zur Biologie und Anatomie der Lianen. Zweiter Theil:—Beiträge zur Anatomie der Lianen, Dr. H. Schenck (Jena, Fischer).—Œuvres Complètes de Christian Huygens, vol. 5 (La Haye, M. Nijhoff).—Statistics of the Colony of Tasmania, 1891 (Tasmania).—Meteorological Observations made at the Adelaide Observatory, &c., 1890 (Adelaide).—Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere, Dr. O. Hertwig (Jena, Fischer).—Topographische Anatomie des Pferdes. Erster Teil:—Die Gliedmassen: Drs. Ellenberger and Baum (Berlin, P. Parey).—Distribution de la Vapeur: A. Madamet (Paris, Gauthier-Villars).—Le Lait: P. Langlois (Paris, Gauthier-Villars).—Universal Atlas. Part 25 (Cassell).

PAMPHLETS.—Diagrams of Isothermal Lines of New South Wales.—Hailstorms: H. C. Russell.—Das Genetische System der Chemischen Elemente: W. Preyer (Berlin, Friedländer),—Further Studies of Yuccas and their Pollination: W. Trelease (St. Louis, Mo.).—Museums Association, Report of Proceedings, &c., at the Third Annual General Meeting.—The Negro in the District of Columbia: E. Ingle (Balt.).

SERIALS.—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, vol. 7, No. 1 (Manchester).—Journal of the College of Science, Imperial University, Japan, vol. v., part 3 (Tōkyō).

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