THURSDAY, DECEMBER 15, 1892.

CRITICISM OF THE ROYAL SOCIETY.

A "Criticism of the Royal Society" which appeared in the *Times* of December 1st is so obviously the work of a writer unacquainted with the inner life of the Society, that it might well have been left to "waste its sweetness on the desert air," had it not been taken seriously in an editorial article of the same issue of the leading journal. In fact, the relations of the "Criticism" to the editorial leader suggest that the discharge of these bombs into the scientific camp was carefully arranged; the writer of the criticism having managed to persuade the editor of the *Times* that the Society is in a bad way. That really is a serious matter, and justifies a brief but careful critique of the "Criticism."

The "Criticism" says:—"The Royal Society is officially and statutorily described as the 'Royal Society for improving natural knowledge,' that is to say for promoting and rewarding original investigation."

The first half of this statement is quite correct, but the second is as completely erroneous. From its earliest days the Royal Society has conferred its Fellowship on persons who had nothing to do, directly, with original investigation, but were promoters of the "improvement of natural knowledge" in other ways. And so very loosely were the conditions of admission construed, half a century ago, that the Society was in danger of sinking into a mere club. From this fate it was rescued by the reform effected by the vigorous efforts of Sir W. Grove and the late Mr. Leonard Horner, which restricted the number of new fellows to be annually *se*lected (not *e*lected) by the Council to fifteen. These fifteen names are presented to a General Meeting which may, if it pleases, reject any or all of them and substitute more or fewer other names. The control of the Society at large is absolute. Nevertheless, in the five and forty years during which this arrangement has existed, we can call to mind only one occasion in which a decision of the Council was seriously challenged in the General Meeting and a name omitted by the Council added to the list. On the face of it, this does not look as if the Council had abused its power of selection.

The "Criticism" proceeds:—"It will hardly be contended by any one at all conversant with the matter that fifteen elections per annum are inadequate for the due recognition of really original work. On the contrary, it is only by a loose and wide interpretation of the governing clause in its constitution that the Royal Society can fill up, year by year, the full number of its permitted elections."

Yet every one "at all conversant with the matter" is perfectly well aware that sundry persons of just weight and authority in the Society have, for some time, been of opinion that the fifteen elections are inadequate even for the purpose of recognizing original work; and that, for a number of years, this view has been pressed now and again on the Council. It is said that if fifteen were considered barely enough forty-five years ago, the prodigious increase of scientific workers, especially in Great Britain and the Colonies, during that time, must have rendered that number insufficient for the present day; and that, seeing the necessity of allotting a fair share of the elections to each of the representatives of the many different branches of Science in a list of candidates whose number averages about sixty, the election of men who ought to come in is, every year, necessarily postponed. We offer no opinion on this difficult question; but that the facts are as we state them is notorious to every one who has served upon the Council. However, it is easy to submit the selective work of the Council to an effectual test. In the last twenty years 300 Fellows have been elected. Let any competent judges go over the names of these gentlemen, with the view of picking out ten whose right to be there admits even of being fairly questioned. We are confident that he will not succeed in finding that number, nor the half of it. No body of men ever has been, or ever will be, unaffected, to some degree, by personal influences, or prejudices, or errors of judgment; even ecclesiastical preferment is said not always to follow in the track of the purely spiritual gifts and graces. But a Council which can defy all hostile criticism of 295 out of 300 of its selections, and fairly defend the rest, may cheerfully meet its enemies in the gate.

The "Criticism" exhibits a no less curious ignorance of the actual facts in dealing with the relations of the officers to the Council. The critic knows nothing of the curious revolt that took place a score of years ago, aided and abetted by the majority of the officers of that time, for the purpose of rendering themselves powerless in face of the rest of the Council. He does not know that, subsequently, officers of the Society have over and over again urged that prolongation of the term of service of the rest of the members of the Council which can alone enable them to take the share they ought to take in the government of the Society. Few persons are aware of the great amount of business—some of it of a very troublesome and responsible character—which comes before the Council of the Royal Society. In his first year of office, a new councillor is a learner; at the end of the second year, just when he is becoming useful, he goes off, by a rule which the general body of the Fellows object to alter. Formerly the President's term of office was unlimited; now it has practically reduced itself to five years. Unless the other officers—and particularly the principal secretaries—retained their offices for a longer time, the affairs of the Society would soon either be reduced to chaos, or be carried on, somehow or other, by the one permanent official—the Assistant Secretary. The Society could not have a better Assistant Secretary than it possesses, but he has no seat in the Council; and even if it were desirable to reduce the secretaries to nullities, the situation would become impossible. Under these circumstances, it is clear that the officers must know more about the business of the Society than ordinary members of the Council; that, therefore, willy-nilly, they must exercise a preponderating influence; and, finally, that it is desirable that they should do so.

Again, the insinuation that this influence is exerted unfairly, in favour of a particular academical institution, could not have been made by any one acquainted with the actual government of the Society. Of the officers, two are members of Scottish Universities, one of thes and two of the others, of the University of Cambridge, one has been honoured by both Oxford and Cambridge degrees. Where is the "excessive representation of one great academical institution" among these gentlemen? Undoubtedly one of the English Universities has a large share; but, if the author of the "Criticism" imagines that the influence of that University, or of any member of it acting on behalf of his University, had anything whatever to do with the election of these officers to the posts they hold, it is simply because he is utterly unacquainted with the circumstances under which these appointments were made; and more especially with the difficulty of finding competent men who are able and willing to devote an immense amount of time and trouble to the affairs of the Society.

So with respect to the "reappearance" of similar names on the Council "every five or six years." If the critic had ever taken part in the business of selecting a new Council; or even if it had occurred to his somewhat captious mind (1) that all branches of science must be represented; (2) that men who can and will give a great deal of time to the service of the Society are alone useful; (3) that it is not everybody's business to be a useful councillor; (4) that people who live far out of London, as a rule, find it difficult to attend the frequent meetings of the Council and its committees, he would not have found it necessary to suggest corrupt motives for this fatal reappearance of the same councillors; and that in spite of the rule that a man must be off the Council for a year before he can be re-elected.

It is further made a reproach to the Society that among the yearly elected fifteen "the professor abounds greatly, while independent investigators of the type of Joule, Brewer, Spottiswoode, De la Rue, Darwin, Gassiot, Grove, and others who have been the glory of English science, are comparatively rare." To which singular statement (most singular perhaps in the collocation of names) it would seem necessary to reply only by putting two questions. Will the critic point to any man ranking even with the least known of those whom he mentions, now living, who is not in the Royal Society, or who has not been placed on the Council, except of his own choice, or from the accidents of residence and occupation? And, secondly, has it occurred to him that in the last quarter of a century, a multitude of new professoriates in science have been created, and have been filled by the best workers the appointers could find? And if these gentlemen have not left off working the moment they were made professors, does it not seem probable that the Council of the Royal Society may have had even better grounds for selecting them for the fellowship than their appointers had for making them professors?

Finally, the "Criticism" affirms that "eminent professors may be named who are also eminent improvers of natural knowledge, yet are not fellows of the Royal Society."

We venture respectfully, but firmly, to question the accuracy of this statement; unless these "eminent improvers of natural knowledge" have voluntarily abstained from seeking the fellowship. It is not for the Council to ask any one, however "eminent," to join the Society. And if there are persons who have been glad to accept honours from the Royal Society's hands, but who have chosen to abstain from taking the steps which would, as a matter of course, have placed them in its ranks and have enabled them to take their fair share in the burden of its work; no one but themselves is responsible for their singular position—the Royal Society *farà da se*, and does not require their aid.

THE ELEMENTS OF PHYSIOLOGY.

Elements of Human Physiology. By E. H. Starling, M.D. Lond. (London: Churchill, 1892.)

IF this book is intended as an introduction to the physiology a medical student ought to acquire it will fill its purpose admirably, but it would be too much to say that it could in any way take the place of the larger text-books. Such a book as this, rightly bearing the word "elements" in its title, if used, as it should be, as a "guide," will give the student an acquaintance with the subject which will be an excellent introduction to more detailed works. Dr. Starling has written in some 400 small 8vo pages a concentrated account of the physiological processes of the body. The knowledge given is fully up to date. It must have been a difficult task to do this in so small a space without merely recording a succession of disconnected facts and rival theories. Dr. Starling is to be congratulated on having accomplished this task well. The judicious selection he has made of the really important points, and his terse and clear mode of expression has enabled him to produce a book which besides being instructive is interesting, which with a condensed manual is seldom the case. The danger of the book lies in its excellence. If a student, a medical student aiming at a mere qualification trusts, with the aid of some histology, to this book alone, he may doubtless accomplish his immediate object. But who would then be satisfied that he possessed a knowledge of physiology such as a medical man should be equipped with? If the student could not merely learn, but also assimilate all that is brought before him here, his mind would not only be supplied with much information, but also receive a useful training. The experience of teachers, however, is that the average student does not understand the intricacies of many of the processes and mechanisms of the animal body by having them tersely expounded to him in a few sentences. He may learn those sentences, but his ignorance is at once exposed if he is brought face to face with the same question along another path. The more a medical man knows of what physiology can teach him of those portions of the science which come into the most intimate relation with medical practice, all the better. The danger is that when this book falls into the hand of the student he will be satisfied, and refrain from consulting fuller works or even from practical laboratory work, on the importance of which the author in the preface so rightly insists.

The introduction gives not only an account of the general properties of living matter, but also a rapid survey of the build and functions of the animal body, touching even on development. This is followed by an account of the chemical constituents, and as this must be largely referred to by the student during the reading of the book, it is a necessity, but would, I think, have been better placed at the end.

In the chapter on blood and lymph a fuller account of leucocytes with their varieties and functions, and especially of the proteid and other substances associated with them, would certainly have been desirable. It is of course easy, in reviewing so small a book, to find instances of curtailment and of omission, but the life history of the leucocytes is of supreme importance medically, that even the account of the derivatives of hæmoglobin might, for their sake, have been shortened.

The phenomena of muscular contraction are well described, and the account of muscle and nerve currents is especially clear and to the point.

In the chapter on the vascular mechanism two tracings of pressure in an artificial schema are taken from Prof. Foster's text-book. The tracings are accurately reproduced. In the description of these we are told that, after a high peripheral resistance is introduced into the circuit, "the pressure on the arterial side at first rises with every beat till it has attained a certain height, where it remains stationary, merely oscillating with every stroke of the pump. The venous manometer, on the other hand, shows no rise of pressure, and its oscillations becomes less and less, till they disappear and the flow becomes continuous." A glance at the tracing shows, however, that there is a rise of pressure on the venous side, and moreover a maintained rise. This is a very important point about the tracing. A student grasps readily the action of the arterial blood pressure in forcing the blood from the aorta to the capillaries, but he is at a loss to understand why it comes back again from the capillaries towards the heart. It cannot be too much insisted on that we have a pressure, a small and gradually falling pressure, in the veins, and that this is the important determining cause of the venous flow. The author, in this the proper place to bring this prominently forward, leaves it out entirely, though it is incidentally referred to later on, and leads the student to suppose that the presence of the valves in the veins and the aspiration of the thoracic movements, important though they may be, are the chief factors.

The subject of endocardial pressure and of the pulse is treated, clearly and concisely, in the light of Hürthle's important work. This is particularly welcome, as, if I am not mistaken, this is the first occasion that these researches have been brought before English readers.

In the discussion of the causation of the heart's beat it does not seem clear why "the beat always starts in the sinus" when we are told that the sinus contracts feebly and slowly. The fact that the sinus has a more rapid rhythm than the other chambers of the heart, and so initiates the whole cycle, is not distinctly brought out. The author follows Schmiedeberg's opinion in stating that muscarin acts by stimulating the nerve-endings of the vagus. This is by no means certain, and we should have welcomed some mention of Gaskell's opinion that its action is a direct one on the muscular tissue, and some of the reasons for taking that view. In the description of the vasomotor mechanisms I have found no adequate statement of the important part vaso-dilator nerves play in regulating the circulation in skeletal muscle.

In the account of the nervous mechanism of respiration, which is well up to date, in including some of the results of the work of Head, we should have expected also some statements of Marckwald's observations on the influence of section of the medulla above the respiratory centre. No reference seems to be made of the influence of impulses reaching the respiratory from higher centres of the brain. It is also unfortunate that when the student turns, as directed, to Fig. 61 he finds that the tracing selected of the effect on the respiration of section of the vagi does not show the increase in amplitude as it does the decrease in rate, although he is told that both the changes are brought about. On page 266 there is an obvious misprint; the word "expiratory" should be "respiratory." On page 291 there is another misprint, "B_2" in the equation should be, of course, "Br." A few lines further on there is, however, a serious error. We read, "From the amount of nitrogen given off the amount of urea present in the urine, may be calculated. 35·5 c.c. of nitrogen correspond to one gram of urea." The theoretical amount calculated for one gramme of urea is 372·7 c.c. at standard temperature and pressure, while 35·5, or more exactly 35·4 c.c., is the amount which Hüfner found was actually liberated not by one gramme, but by one decigramme of urea.

The chapters on the special senses and on the central nervous system are some of the best in the book. The methods of tracing fibres in the cord and brain are fully gone into, so also is localization of function, and indeed the account of the brain throughout is very clear and good.

At the end of the book is a short appendix, in which is given a description of apparatus purely physical in nature. Every teacher will agree with the author that it is not only desirable, but necessary, to put this in a manual of physiology. The ignorance of the construction and use of the simplest physical apparatus, which the average medical student carries with him into the physiological laboratory, is usually almost as perfect as it can be. Much of the time of a demonstrator of physiology has at first to be given to the teaching of some of the simplest physical methods. L. E. S.

APPLIED MECHANICS.

Elementary Manual on Applied Mechanics. By Prof. Jamieson. (London: C. Griffin and Co., Limited, 1892.)

THIS is the latest addition to the series of books introduced by Prof. Jamieson during the last few years. Like his useful work on the Steam Engine, it is the outcome of the course of lectures which he delivers to his own students. It is replete with the many mechanical contrivances to be found in the workshop, one chapter being devoted to the consideration of the screw-cutting lathe alone.

The illustrations, with which the book abounds, and the necessary descriptions of the various machines considered, are all that one may wish for.

An excellent feature of the book will be found in the manner in which, after having enunciated a principle, the author has applied it to some well-chosen examples. In this direction he has proceeded to an extent which will be highly appreciated by the student. Further, he has availed himself of any opportunity to obtain results experimentally, and these form a very instructive series of examples for the young engineer.

A careful perusal will show that the author considers it desirable that all matters pertaining to units, definitions, symbols, &c., should be carefully attended to. But in his treatment of these he has not been entirely successful.

Take, for instance, his definition of the moment of a force on p. 15:—"The moment of a force is equal to the force multiplied by the perpendicular distance from a point on its line of action." This is rather ambiguous, and we should prefer to see the words, *with respect to a point*, included in the definition.

In a footnote, p. 214, objection is taken to f being used for acceleration, since it "naturally represents a force." Then why use e for strain in the formula $e = \frac{l}{L}$, where e just as naturally represents an elongation, and strain is not an elongation, as the author clearly shows in another footnote on p. 232?

Again, in a footnote on p. 2 we have: "$M = \frac{W}{g}$, where M stands for the mass, W for the weight in pounds, and g for the acceleration of gravity."

Now on p. 215 the reader is asked to accept as correct the formula for centrifugal force, $P = \frac{Wv^2}{gr}$ lbs., but (continues the author) since $M = \frac{W}{g}$, then $P = \frac{Mv^2}{r}$ poundals. Why should this substitution produce the change from pounds to poundals? We fail to see what is gained by having an ellipse for the figure representing motion in a circle.

There is a want of consistency when an acceleration is spoken of as "a feet per sec. in one second" in one place, and as "a feet per sec." on p. 219. On the same page, too, $\frac{Wv^2}{2a}$ should evidently be read as $\frac{Wv^2}{2g}$.

The examples worked out in the chapter on bending moments will show the student how to apply the principle of moments to the case of a beam loaded in any given manner. This is preferable to merely using a set of formula, a system attended with most disastrous results.

At the end of each chapter will be found a good selection of examples on the matter considered therein. We are informed that another volume dealing with the more advanced portions of the subject is in the course of preparation. G. A. B.

OUR BOOK SHELF.

Man and the Glacial Period. By G. Frederick Wright, D.D., LL.D., F.G.S.A. (London: Kegan Paul, Trench, Trübner and Co., 1892.)

THE title of this book raises expectations which the contents fail to satisfy. Out of 374 pages only sixty are devoted to the consideration of "the relics of man in the Glacial Period," and the treatment of the subject is, to say the least, uncritical. The reader does not learn from Prof. Wright that strong doubt has been expressed as to whether some of the "finds" of human relics in North America were really made in undisturbed glacial deposits, while his discussion of the European evidence is crude and inadequate, not to say misleading. The author has apparently only a slight acquaintance with the literature of the subject, acquired chiefly from such recondite sources as Lyell's "Antiquity of Man," and treatises on general geology. Of the many interesting facts bearing on man's relation to the Ice Age which have been discovered since those works were published our author is apparently ignorant. Nor has "a summer spent in Europe" sufficed, as who could expect that it should, to make up for his other deficiencies. Fortunately, the major portion of his volume deals with the glacial phenomena of North America, for here he is on safer ground. We feel sure, however, that many of his statements and conclusions will receive scant support from geologists across the water. It would be interesting to know, for example, what evidence can be adduced to show that the southern part of the United States was submerged during the Glacial Period to the extent of 500 feet, so as to bring the waters of the Gulf of Mexico into Illinois and Indiana. Again, we were under the impression that the author's "Ohio Lake," which he supposes came into existence when the great ice-sheet advanced into that region, had been effectually disposed of by Mr. Leverett and Prof. Chamberlin. Throughout the book the unity of the glacial period is confidently upheld, a view which Prof. Wright is, of course, entitled to maintain; but he might have informed his readers that with few exceptions American geologists are quite of another opinion. He fails to understand the evidence adduced by Chamberlin and others in favour of the periodicity of glaciation, while so far as one can gather from his pages, he seems to know nothing of the facts bearing on this question which geologists in Europe have accumulated, especially during the past few years.

Altogether we much prefer the author's earlier work, "The Ice Age in North America," of which the present is more or less of an abstract. In the former the facts of American glacial geology were given in considerable detail, and the writer's crude speculations and hypotheses were less obtrusive. Should the present work come to a second edition we would advise Dr. Wright to get some scientific friend to assist him in its revision. Loose unscientific phraseology and incorrect definitions are of not infrequent occurrence throughout the volume. Thus we read of "glacial ice," of "beautiful crystals of porphyry," &c., and are told that névé is the "motionless part" of a glacier, although a little further on we learn that it is from this "motionless" névé that "the glacier gets both its supply of ice and the impulse which gives it its first motion." Obviously Dr. Wright is unacquainted with the observations of MM. Pfaff, Kloche, and Koch on the movement of névé, while he might increase his knowledge of glacier motion by studying what Messrs. McConnel and Kidd have to say upon that interesting subject.

Beetles, Butterflies, Moths, and other Insects. By A. W. Kapple and W. Egmont Kirby. (London: Cassell and Co., 1892.)

THIS work is a slight sketch of the more prominent British insects, intended for youthful and very inexperienced entomologists. The first section is devoted to classification, the key to the orders of insects being a fairly workable one, though it takes no account of the very numerous exceptions. Then follows a section on structure, in which when describing the eye the authors ignore the latest experiments on the subject, proving that the compound eyes form but a single image of the object seen; they also treat the tongue or proboscis as if it were homologous throughout the orders, whilst in lepidoptera it is developed from entirely different organs from what it is in the others, except in the very lowest family; and again when describing the legs they fall into the almost incredible error of speaking of the first joint as the trochanter, saying it is joined to the thorax by a hingeplate, the coxa, the first joint being in fact the coxa and the trochanter, the short joint articulating it to the femur. Then follow short sections on the metamorphoses of insects and their habits and haunts, and longer sections on the collecting and preserving of perfect insects and larvæ, which are far more correct than the preceding ones, though very slight and quite insufficient for the initiation of a beginner. The main part of the book is devoted to short descriptions of the more prominent British insects under their various orders and families, and illustrated by twelve coloured plates, which are decidedly good for cheap chromographic work; this is by far the most useful portion of the book, and well-marked forms will easily be recognized from the figures and descriptions, even though many species are placed in their wrong families.

Ostwald's Klassiker der Exakten Wissenschaften. Nos. 31–37. (Leipzig: Wilhelm Engelmann, 1892.)

WE have already called attention to this admirable series of small volumes. It consists of scientific papers which may be said to have marked definite stages in the development of science. The only fault we have to find with the series, as we have already stated, is that only the German papers are given in the language in which they were originally written. All the others are translated. This is undoubtedly a mistake, for much may often depend on the precise words used by a great master of research. In other respects the series is excellent, and should be of genuine service to scientific students. The papers reproduced in the present set of volumes are Lambert's "Photometrie," three volumes (1760); photo-chemical researches, by R. Bunsen and H. E. Roscoe (1855–59); an attempt to find the definite and simple conditions in accordance with which the constituent parts of inorganic nature are connected with one another, by Jacob Berzelius (1811–12); on a general principle of the mathematical theory of induced electrical currents, by Franz Neumann (1847); observations on the moving power of fire and the machines fitted for the development of this force, by S. Carnot (1824).

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

"Aminol, a True Disinfectant."

WILL you grant me space, in order to avoid misunderstanding, to make the following explanation?—

(1) I recently learned that certain samples marked "Aminol, a true disinfectant" have been sent to various gentlemen, accompanied by a leaflet, in which my name, without my authority, is associated with those samples. Allow me to inform your readers that those samples contain "aminol" in water in the strength of one in five thousand. Now, the experiments which I carried out with "aminol," as regards its disinfecting power of microbes, were made with a solution of the strength of one in six hundred, and the disinfecting power of this strength was the following: spores of *Anthrax bacilli* remained unaffected after eight hours' exposure, only after an exposure for twenty-four hours did the number of living spores decrease, but some escaped disinfection even after so long an exposure. *Anthrax bacilli*, *Staphylococcus aureus*, and others were destroyed, but only after a prolonged exposure.

(2) A substance is advertised and circulated under the name of "Periodate crystals," and is associated with my name without my authority. Until quite recently I have made no experiments with it. A few years ago I made a few experiments, merely of a tentative character, with a solution which was labelled "Periodate," but not with the substance advertised as "Periodate crystals." With these latter I have recently made experiments, and I find that their solution in full strength has no disinfecting power on microbes, pathogenic and non-pathogenic, amongst which may be mentioned the bacillus and spores of anthrax, the bacillus of typhoid and of diphtheria, of cholera and of erysipelas, the *Bacillus prodigiosus*, the *Staphylococcus aureus*, and others. Likewise I find that injection of large quantities of the solution into guinea-pigs already infected with anthrax or diphtheria, has no power whatever in arresting or altering the normal course of these diseases to their fatal issue.

E. KLEIN.

Tracery Imitation.

I TOOK occasion some months ago to publish the result of observations on my child H.'s progressive attempts at drawing after outline "copies" set before her.[1] Examination of the series of her drawings made almost daily during the period from her nineteenth to her twenty-seventh month showed in them no apparent form or shape. They are simply vigorous pencil markings, answering as well to one "copy" as to another—or to none. Quite suddenly, however, in her twenty-eighth month, she seemed to catch the idea of breaking the "copy" (man) up into parts, and succeeded in making head, body, arms, legs, &c., in sufficient degree of relative proportion to show that here was, in her case, the rise of what I called in the article cited, "tracery imitation" of a visual picture.

At that time I had no explanation to offer, but simply recorded the observation. I have now, however, reached a way of explaining the rise of this apparently abrupt connection between muscle-sense and sight—an explanation suggested to me by a passage in Stricker's argument for the eye-movement theory of the visual apprehension of figure or outline.[2]

Before a child begins to acquire "tracery imitation," his drawings have no shape, but they show uniformly certain systems of angles, curves, &c., due to the easiest and most natural movements of the arm. The eyes, however, have been in a measure already educated to recognize certain shapes or "copies." There are, therefore, in consciousness two series of associations—one of eye-movement sensations, a, a^1, a^2, a^3, a^4, &c., with a certain strength of revival, which we may call x: the other, an associated series of arm-movement sensations, n, n^1, n^2, n^3, n^4, &c., representing a path of least resistance in arm movement. Let us call its strength or degree of tendency to progressive revival y.

Now, before the rise of "tracery imitation" y is greater than x, for the reason that the arm is restricted to a very few movements, and these are largely automatic. Once start one of these movements, and the tendency to carry it out is very strong. The tendency of the eye-movement series, on the contrary, to regular revival is slight; very few objects, copies, &c., being so clear and isolated as to give frequent unbroken reproductions. Consequently, the arm-movement series, n, n^1, n^2, &c., wins the day, and an abortive "drawing" is the result.

But the time comes soon when the reverse is true—when x is greater than y. The eye-movement series gets strengthened constantly by the repeated exploration of familiar figures, especially if, as in the case of my child, the eye be trained by having the same "copies" set from day to day. On the other hand, the arm and hand movement series gets constantly lesser and weaker, since the increasing mobility of the muscles, in the varied new activities of this period of infancy, is acquired at the direct expense of the early "cast-iron" reactions which are largely organic. Both of these tendencies were very marked in H.—the first, in the more pronounced recognition of the "copies" set before her; the second, in the less uncouth manner of holding her pencil, moving the fingers, disposing the arm, &c. Hence, it is simply a matter of education that x should soon overweigh y, and the elements of the eye series a, a^1, a^2, a^3, &c., should draw after them the arm series.

An association thus begins to be formed between the several members of the a series and certain correct elements of arm sensation: these latter go to form, under this leading, a new n series, which gradually becomes independent as an acquisition. That each new tracery combination is thus learned separately is seen in the fact that after H. learned to trace certain "copies" (man, bird), she was yet entirely unable to trace any others.

[1] *Science*, New York, January 8, 1892.
[2] "Du Langage et de la Musique" (French ed.), chap. xxii.; see also his "Studien über die Association der Vorstellungen."

She was even unable to trace a circle, except as part of a man (the head).

In a paper presented at the London meeting of the International Congress for Experimental Psychology last August, I insisted that voluntary movements are possible in the child only after a great variety of motor "elements" have become available through great diffusion and mass in involuntary (imitative) reactions.[1] The above phenomenon, thus explained, serves to illustrate the broader position.

As there is no literature on this subject, the question of "tracery-imitation" has not even been put before, to my knowledge, I should be glad to have opinions upon it. It is evident that if one hold the other theory of the visual apprehension of figure, *i.e.* that it is given by sight apart from sensations, of eye-movement, he could still hold the explanation which I have offered above, by substituting for the series of eye-movement sensations, a, a^1, a^2, &c., a series of visual sensations, v, v^1, v^2, &c. J. MARK BALDWIN.

Difficulties of Pliocene Geology.

CONSIDERING the very great importance which the later tertiary beds must occupy in all speculations about the origin of man and the present geographical distribution of plants and animals, it is unfortunate that they should have attracted so little attention among English geologists.

The fact is perhaps not unnatural when we consider how very scantily they are represented in this country; the Norwich Crag being virtually the only bed where remains of pliocene land animals have occurred. The Norwich Crag is itself a very puzzling bed, where marine remains and land remains are found mixed together, the whole having been reassorted, and I do not know of a single pliocene land surface remaining intact in Britain. The so-called forest-bed can no longer be classed as pliocene, but is clearly of pleistocene age. A real mark of the true pliocene horizon in Europe is the occurrence of the mastodon and its associated fauna.

If we are to use the mastodon as a test we shall have to travel southward as far as Auvergne, if we are to find a pliocene land surface *in situ*. Unfortunately Auvergne is a very dislocated and broken country, and the sequence of the later deposits is very hard to make out, and I much question whether it be possible to find sections showing the true reading of the beds in question nearer than Florence.

I am writing in the hope that I may persuade Dr. Forsyth Major, who knows the valley of the Arno so well, to communicate to NATURE some account of the results arrived at by the Italian geologists.

At present the question is one of great perplexity. Let me refer to two points. First, How comes it that in no part of the world, so far as I know, has a single fragment of an undoubted pliocene beast been found in a cave? The carnivora of pliocene times must have frequented caves just as much as the bears and hyenas of pleistocene times, yet how comes it that we can nowhere find any tertiary remains in any cavern? It will not do to appeal to denudation, for if there be deposits anywhere protected from denudation it is those in caves. Can it be that every mountain chain where limestone rocks occur is younger than pliocene times?

Again, we know that in America, both north and south, the mastodon survived to the end of the Pleistocene age, and lived alongside of the mammoth and the Columbian elephant. In Europe there is very great doubt whether the mastodon and any form of elephant were ever contemporaries. No doubt the teeth of the mastodon have been found with those of the elephant in the Crags, but the Crags have been so rearranged that it is impossible to draw any safe conclusions from them. It is at all events extraordinary that, according to the French geologists, the two beasts have never been found together in France. I believe the same conclusion has been arrived at by the Italian geologists, but upon this point there is some uncertainty, and it would be very interesting to have the opinion of so competent an authority as Dr. Forsyth Major upon the point. It is one of importance, for upon it depends largely the question of whether there was a continuity in Europe between the pliocene and pleistocene land, or whether, as I am disposed to believe, there was a break between the two involving perhaps a violent revolution. There are other interesting questions involved in the issue I have raised, upon which you may possibly permit me to write on another occasion. Meanwhile the burden of my present letter is to point out how little we really know about the pliocene land, and how useful it would be to know more. HENRY H. HOWORTH.

The Athenæum Club, December 5.

Meteors.

A FINE meteoric shower was observed here on the night of November 23, from 7h. 30m. to 12h. 30m., when the observations were interrupted by cloud.[1] The meteors were evidently "Bielids," the radiant at 8.30 being near a point, R.A., 1h. 20m.; Dec., 40° 30′. The radiant, however, was not well defined, its area being at least 4° in diameter. For a single observer, in a position which commanded only about one-sixth of the visible hemisphere, the meteors numbered about six a minute, which would indicate at least seventy-five a minute for the entire sky, exhaustively observed.

At ten o'clock two observers, standing back to back in an open space, counted 104 meteors in five minutes; the position of the radiant being then, R.A., 1h. 30m.; Dec., 41° 30′—very near Upsilon Andromedæ. At this time the radiant seemed to be rather more definite than earlier, and several nearly stationary meteors determined the place with reasonable precision.

An hour later a similar count by the same two observers gave 100 meteors in four minutes and a half, and the radiant was determined at R.A., 1h. 40m., Dec., 40°. The rate of frequency continued about the same until the sky clouded up an hour later, and must, I think, be estimated as high as from 80 to 100 a minute for the whole number that might have been seen by a sufficient corps of observers. This would foot up from 24,000 to 30,000 for the five hours.

I am not quite certain whether the apparent change in the position of the radiant is, or is not, real; but a motion very similar in amount and direction is given by Denza in his observations of the meteoric shower of 1885 (see NATURE, vol. xxxiii. page 151).

Comet "*f*" (Holmes's) was about 10° west and 4° south of the mean radiant at R.A., 0h. 40m., Dec., 360° 45′. It was barely visible to the naked eye.

Most of the meteors were very small, not exceeding the fifth magnitude; but a few, perhaps one in ten, were above the second, and in the course of the night four were seen which rivalled or surpassed Jupiter. The brighter ones left bluish trains, which remained visible for three or four seconds. The smaller ones often came in "flights" of three or four together, and fully half the paths were more or less curved and wavy from the resistance of the air.

It is worthy of notice that the heliocentric longitude of the earth at the time of the shower was about 62°, instead of 65° which was the longitude of the descending node of Biela's orbit at the last appearance of the comet in 1852, and was the longitude of the earth at the time of the showers of 1872 and 1885. The fact suggests the inquiry whether perturbations since 1885 will fairly account for such a recession of the node.

It is obvious also that if the meteoric swarms encountered by the earth in 1872 and 1885 were really moving in the orbit of Biela's comet (which at its last appearance had a period of 6·6 years), then the swarm encountered the other night, just seven years later, must have been an entirely different one—unless indeed the perturbations since 1885 can account for a retardation of nearly five months.

Last night was for the most part overcast, but a watch of fifteen minutes through occasional openings in the clouds showed only one or two possible Bielids. Evidently the shower was not continuing with any intensity. C. A. YOUNG.

Princeton, N.J., U.S., November 25.

Comparative Sunshine.

AFTER explaining that by "sunshine" I intend that which *would* fall upon the earth if there were no atmospheric obstruction, one must first notice the very elementary truth that the amount of such sunshine at any assumed time and place is in proportion to the altitude of the sun at noon, and also the

[1] An abstract of the paper is to be found in *Science*, November 18, 1892, and also in the Proceedings of the Congress.

[1] Our "Eastern standard time" is just five hours slower than Greenwich time.

length of the day. Except at the time of the equinox, the gradual lengthening or shortening of the day, as the solstice is approached, most materially affects, especially in the higher latitudes, the total amount of sunshine received in twenty-four hours.

But are there any convenient and readily accessible tables—as there easily might be—which would at a glance show numerically the comparative amounts of sunshine at certain selected times and places? I would wish to see such tables, say, for every tenth day, for the three months from an equinox to a solstice, for about every third degree of latitude in each hemisphere. I see not how, without this, either the causes or the effects of meteorological changes in different regions at different seasons can be justly estimated. I would propose to express the amount of sunshine during twelve hours at the equator at the equinox by, say, 100; the figures rising above this, or falling below it. Thus there would be more than 100 given for the latitude of the Tropic of Cancer at the summer solstice, with a vertical sun and more than twenty-four hours' sunshine; with 100 for a latitude still further north. REGINALD COURTENAY.

The Imperial Hotel, Sliema, Malta, November 14.

Quaternions.

BY the kindness of the author I have just received a copy of Mr. Heaviside's paper "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field" (*Phil. Trans.*, 1892, p. 423), in which he reopens a question debated in your columns some time ago—the question of Quaternions *versus* other methods of vector analysis for the use of physicists.

At present the matter stands thus:—There are two widely-known systems of vector analysis before the public—Quaternions and the Ausdehnungslehre—and quite a multitude of less known ones, of which Prof. Gibbs's seems to be one of the least open to objection, and of which, in my opinion, Mr. Heaviside's is by no means so. It would take too long, however, to justify this opinion, but I wish to make an appeal to Mr. Heaviside and Prof. Gibbs on grounds independent of the merits or demerits of their particular systems.

Of the Ausdehnungslehre I do not feel competent to speak. As to Quaternions, there are undoubtedly some inconveniences in physical applications, and I am quite willing to concede that a grave one is the very frequent use of the letters S and V (Mr. Heaviside uses the latter). I do not regard the sign of the scalar product which vexes the soul of Mr. Heaviside as of any consequence. But while thus admitting that a better system than Quaternions is conceivable, I think I can show that the position of the dissenters is little short of suicidal.

The band of physicists who use and urge the use on others of vector analysis is woefully small. Let me put a question to two of the justly best known of that band, Prof. Gibbs and Mr. Heaviside. What is the *first* duty of the physical vector analyst *qua* physical vector analyst? I think I may anticipate that the answer will be—to convince the world of mathematical physicists that vector analysis must be unshelved and set to work. The next question that arises is one of tactics. What should be the plan of campaign to bring this desirable result about? Here I am afraid we cannot hope for unanimity even among the members of the small band, and this is to be most grievously deplored. But surely every sane man will agree that what most certainly the analysts should not do is to present their arguments to those they would convince in a dozen different mathematical languages, each of which is puzzling enough to those learned in allied languages. Grant this, and it follows that Quaternions and the Ausdehnungslehre should be left in sole possession of the field. The day for Prof. Gibbs's improvements is not yet. Prof. Gibbs and Mr. Heaviside have not yet convinced the rest of the small band—not to say each other—of the merits of their algorithms. Let me implore them to sink the individual in the common cause, and content themselves with the faith that posterity will do them justice.

Apart from the question of notation there seem to be two schools of opinion as to the proper conduct of the campaign. To vary the metaphor, Maxwell, Clifford, Gibbs, Fitzgerald, Heaviside prescribe a course of spoon-feeding the physical public. Hamilton and Tait recommend and provide strong meat. I do not think that harm, but rather good, will come from this double treatment, as one course will suit some patients and the other others. *But* let the spoon-feeders provide spoon-meat of the same *kind* as the other physicians. Is not Maxwell, Clifford, and Fitzgerald's food as digestible as Prof. Gibbs's and Mr. Heaviside's? ALEX. MCAULAY.

Ormond College, Melbourne, October 31.

Animals' Rights.

MR. SALT disputes the justice of the statement that he has given two contradictory definitions of animals' rights, inasmuch as, according to him, that which he has set forth on p. 28 is but a repetition and amplification of the one to be found on p. 9.

By the definition on p. 9 animals' rights are said to consist in a "due measure" of the restricted freedom which constitutes the right of man, *i.e.* (as Mr. Salt notes) the freedom "to do that which he wills, provided he infringe not the equal liberty of any other man"—"a restricted freedom" which guarantees to the harmless individual *the security of his life and liberty.*

But on p. 28 the rights of animals (which were said before to consist in a "due measure" of that just quoted) being here stated to be "subject to the limitations imposed by the permanent needs and interests of the community," are found to be burdened with so serious a qualification that *security for the life and liberty of the harmless individual is by it completely destroyed.*

A European might settle with confidence in an unknown island, on the assurance that he would be allowed a measure of the general right of the natives to the freedom to do that which they would, provided they infringed not the equal rights of any other, but were he afterwards to discover that the "measure" of this right which was considered to be the "due" of a foreigner was in reality limited "by the needs and interests of the community," and that, a community where the custom of enslaving and eating strangers had existed from time immemorial, we venture to assert that his departure from the island would be effected with as little delay as possible. We should much regret misrepresenting Mr. Salt's statements, but the assertion that the second definition of rights is but a repetition and amplification of the first is manifestly untenable, and if, by "*due measure*" for animals of the rights of man, Mr. Salt would have us understand that he meant—only such a measure as is consistent with the nullification of the most fundamental privileges secured by them, he must have been discussing the subject in a vein of sarcasm which we are bound to confess we had quite failed to appreciate.

THE REVIEWER.

The Height and Spectrum of Auroras.

THERE was a magnificent aurora on the evening of the 4th, part of which, from 10h. 46½m. to 48m. or 49m., was an intense red. I noted the positions of some of the features at the exact half-hours and also at some other times, for comparison with any observations that may have been made in other places, for ascertaining the height of the phenomenon; and I hope some such observations have been made of the recent display, and will be made of further ones in the future, for Dr. Veeder, of Lyons (New York), has kindly consented to calculate the heights from the observations.

I am surprised that none of our persevering photographers have as yet obtained a good photograph of the auroral spectrum. I do not think it would be more difficult than the stellar photographs that have been taken, seeing that the exposure might go on for hours. It would be desirable to have it done with a camera that could be pointed in any direction at will, so that wherever the observer saw a bright portion of the aurora he could direct the instrument to it. T. W. BACKHOUSE.

Sunderland, December 6.

The Teaching of Botany.

THERE appeared in NATURE (vol. xxxi. p. 229) a paper entitled "Experiments suitable for illustrating Elementary Instruction in Chemistry," by Sir H. E. Roscoe and W. J. Russell. I have long felt the want of a similar series of experiments in physiological botany. There is not much difficulty in teaching the morphological side of the subject, but it is not easy for the ordinary high-school teacher to devise and carry out a suitable series of experiments for demonstrating the more important aspects of physiological botany. If some master in the subject would do for botany what Sir H. E. Roscoe has done for chemistry he would confer a great boon on teachers and young students. A. H.

Egyptian Figs.

MY attention has been called to a very obvious slip of the pen in my note on Egyptian Figs, in that I have written "Pliny' instead of "Theophrastus." The former, as all know, was a *Latin* author, but he simply copies from the latter. Having both authors before me at the time, I accidentally put one name for the others. The refs. are as follows:—Theoph. iv. 2; Dioscor. l. 1; Plin. xiii. 7. GEORGE HENSLOW.

A Palæozoic Ice-Age.

I CANNOT understand how, when writing on this subject (*ante*, p. 101), I overlooked the circumstance that the ancient boulder-beds of Australia, India, and South Africa received full notice in Prof. J. Prestwich's "Geology," vol. ii. pp. 143-146.
December 9. W. T. BLANFORD.

SCHEELE.

DURING this month Sweden commemorates the one hundred and fiftieth anniversary of the birth of one who has conferred an imperishable lustre on her annals. Carl Wilhelm Scheele—although a German by nationality, for he was born at Stralsund, the capital of Pomerania—spent practically the whole of his short life in Sweden, and is usually regarded as a Swede. The son of a tradesman, Joachim Christian Scheele, and the seventh child of a family of eleven, Scheele, as a boy, gave little promise of the genius and power which astonished the scientific world towards the close of the last century. It is perhaps indicative of a certain mental imperfection that he should have been wholly incapable of learning a foreign language; although he lived in Sweden during more than half his life his knowledge of Swedish was so imperfect that his memoirs, addressed to the Academies of Stockholm and Upsala, were invariably written by him in German and had to be translated by others before publication. By what influences he was led to the study of chemistry is unknown. There was nothing apparently in his home life, or in the mode or circumstances of his education to direct his inclination towards science. As a boy he began the study of pharmacy, and at his own wish was apprenticed to an apothecary at Göteborg named Bauch, with whom he remained eight years. Here he had access to the standard treatises on chemistry of that time, and he devoted all his leisure, often working far into the night, to the study of the works of Neumann, Lemery, Kunkel, and Stahl. Kunkel's Laboratorium was, indeed, his chief instructor in practical chemistry, and it was by diligently repeating, in the first instance, the experiments contained in that book that he acquired that extraordinary manipulative skill and analytical dexterity on which his success as an investigator ultimately rested.

When twenty-three years of age Scheele removed to Malmö, and some years afterwards to Stockholm, where he superintended the shop of an apothecary named Scharenberg. It was about this time that his career as a discoverer began, by the isolation of tartaric acid from cream of tartar. He ascertained many of the characteristic properties of this acid and prepared and examined a number of tartrates. These early efforts met, however, with a somewhat untoward reception. It seems that Scheele drew up an account of his observations and forwarded it to Bergman, who then filled the chair of chemistry in the University of Upsala as the successor of Wallerius. Bergman failed to appreciate the significance of the work of the young and unknown apothecary and by some mischance the manuscript was lost. The importance of the discovery was, however, recognized by Retzius, who induced Scheele to write a second account of his work and to submit it to the Academy of Sciences at Stockholm, by whom it was eventually printed. In 1771 Scheele published his memorable essay, "On Fluor Mineral and its Acid," in which he first demonstrated the true composition of fluor-spar, showing that it "consists principally of calcareous earth saturated with a peculiar acid," named by him "fluor-acid." Although he found that the "fluor-acid" (hydrofluoric acid) dissolved "siliceous earth," he failed to recognize the change thereby produced in the "fluor-acid" and was thus led to an erroneous conception of its real nature. He was in fact led astray by the circumstance that his experiments were for the most part made in glass vessels, and hence the fluor-acid was contaminated with more or less silica and hydrofluosilicic acid. The origin of the silica in the acid prepared by Scheele was first clearly indicated independently by Wiegleb and Meyer. In 1773 Scheele went to Upsala as pharmaceutical assistant to Mr. Lokk, in whose shop he chanced to meet the chemist Gahn. Lokk and Gahn were speculating on the cause of the different mode of action of distilled vinegar on nitre before and after fusion. This was explained by the young assistant, who pointed out the nature of the change effected on nitre by fusion; and the fact that it is converted into a salt (potassium nitrite) from which a peculiar acid, different from true "spirit of nitre," can be obtained by treatment with distilled vinegar. Gahn, struck with the sagacity of the young pharmacist, offered to introduce him to Bergman. The invitation was at first declined; Scheele had not forgotten the unfortunate incident of the tartaric acid memoir. Eventually he allowed himself to be convinced that Bergman's action was due more to inadvertence than to indifference, and the acquaintance which followed rapidly ripened into a strong friendship. In 1774 Scheele, at the suggestion of Bergman, published his well-known memoir "On Manganese, Manganesium, or Magnesia Vitrariarum." This essay, although marred and in part obscured by the phlogistic conceptions of the period, will for ever remain one of the classics of chemistry. In it Scheele not only established the nature of "pyrolusite" or "wad," but, in studying the action of acids upon the mineral, he was led to the discovery of baryta and of chlorine, the properties of which he minutely describes. In 1775 appeared his memoir on arsenic acid which he prepared in several ways; he discovered many of the more striking properties of this body and obtained a number of its salts. In the course of the investigation he discovered arseniureted hydrogen, and the well-known pigment Scheele's Green. In the same year he published his essay on benzoic acid, the "flowers of benzoin" of the apothecary. After a stay of two years in Upsala Scheele was appointed by the Medical College *provisor* of the pharmacy at Köping, a small town on the north shore of Lake Mälar. Instead of the prosperous business he had been led to expect he found nothing but discomfort and disorder, and the remainder of his life was spent in a constant struggle with privation and debt, relieved at length, to some extent, by a grant, at Bergman's instigation, from the Stockholm Academy. Of this money Scheele set aside one-sixth for his personal necessities, and devoted the remainder to his researches. In 1777 he took over the business of the pharmacy from the widow of the former proprietor, but it was only by unremitting industry that he was able to discharge the obligation he thereby incurred. Not a year passed, however, without Scheele publishing two or three memoirs, every one of which contained a discovery calculated to enhance his reputation as the greatest experimenter of his time. This untiring devotion to science at length began to tell upon a frame constitutionally weak and doubtless further enfeebled by privation, and by the worry of debt and difficulties. He struggled on, however, a martyr to rheumatism and suffering from a complication of internal disorders until he was struck down in the spring of 1786. Some time before his fatal illness he had formed the resolution of marrying the widow of his predecessor so soon as his circumstances should permit: on his death-bed he carried out this project, bequeathing to his wife such property as he had been able to acquire. Two days afterwards (May 21, 1786) he died at the age of forty-four.

The eleven years during which Scheele lived at Köping were fruitful in investigations of the highest importance in every department of chemistry. In that time he discovered molybdic, tungstic, and arsenic acids among the inorganic acids; and lactic, gallic, oxalic, citric, malic, mucic, and uric among the organic acids. He also discovered glycerin, determined the nature of Prussian blue, and prepared hydrocyanic acid. He demonstrated that plumbago is nothing but carbon associated with more or less iron, and that the black powder left on the solution of cast-iron in mineral acids is essentially the same substance. He determined the chemical nature of sulphuretted hydrogen, discovered arseniureted hydrogen, and invented new processes for preparing ether, powder of algaroth, calomel, and *magnesia alba*. He made numerous analyses of air by absorbing the oxygen with a mixture of iron filings and sulphur. He concluded that "our atmosphere contains always, though with some little difference, the same quantity of pure or fire air [oxygen] viz. $\frac{9}{33}$ which is a very remarkable fact; and to assign the cause of it seems difficult, as a quantity of pure air [oxygen] in supporting fire, daily enters into a new union; and a considerable quantity of it is likewise corrupted or changed into aerial acid (carbon dioxide) as well by plants as by respiration; another fresh proof of the great care of our Creator for all that lives."

Scheele's greatest work, however, is unquestionably his treatise on "Air and Fire," which appeared in 1777 with a preface by Bergman, who, according to Thomson, superintended its publication. This elaborate essay shows Scheele at his best and at his worst; it testifies to his genius as an experimentalist and to his weakness as a theorist. No one can read this, or indeed any other of Scheele's memoirs, without being impressed by his extraordinary insight, which at times amounted almost to divination, and by the way in which he instinctively seizes on what is essential and steers his way among the rocks and shoals of contradictory or conflicting observations. No man was ever more staunchly loyal to the facts of his experiments, however strongly these might tell against an antecedent or congenial hypothesis. Had Scheele possessed that sense of quantitative accuracy which was the special characteristic of his contemporary Cavendish, his work on "Air and Fire" would inevitably have effected the overthrow of phlogistonism long before the advent of Lavoisier. His memoir is essentially an essay on oxygen, of which he was an independent discoverer, in its relations to life and combustion. It is perhaps idle to speculate on the causes which prevented his clear recognition of the full truth. It may have been that he was essentially a *preparateur* like Priestley, and that quantitative chemistry had few attractions for him; it is far more probable that the character of his work was determined by the circumstances of his position, by his poverty, his lack of apparatus, and his want of assistance. As it is, it remains one of the most remarkable circumstances in the history of human knowledge that a man working under such adverse conditions in a small village on the shore of a Scandinavian lake should have been able to change the entire aspect of a science.

It was stated by Crell, the editor of the well-known *Neue Entdeckungen* and *Annalen*, in which many of Scheele's papers first appeared, that the great Swedish chemist was invited to this country with the offer of an easier and more lucrative position than that which he had at Köping; but that his partiality for Sweden and his love of quiet and retirement delayed his acceptance of the offer until a change in the English ministry put a stop to the negotiations. Thomson, the author of the "History of Chemistry" in mentioning this circumstance, expresses his doubts as to its truth, and states that he made enquiries of Sir Joseph Banks, Cavendish, and Kirwan, but none of them had ever heard of such negotiation. Indeed the circumstance is intrinsically improbable. "I am utterly at a loss," says Thomson, "to conceive what one individual in any of the ministries of George III. was either acquainted with the science of chemistry or at all interested in its progress. . . . What minister in Great Britian ever attempted to cherish the sciences, or to reward those who cultivate them with success? . . . If any such project ever existed, it must have been an idea which struck some man of science that such a proposal to a man of Scheele's eminence would redound to the credit of the country. But that such a project should have been broached by a British ministry, or by any man of great political influence, is an opinion that no person would adopt who has paid any attention to the history of Great Britain since the Revolution to the present time."

T. E. THORPE.

WERNER VON SIEMENS.

ERNST WERNER SIEMENS was the eldest son of Christian Ferdinand Siemens and Eleonore Deichmann; he was born in 1816 at Lenthe in Hanover, where his father was engaged in the business of agriculture and forestry.

From his very childhood the subject of this memoir learnt the lessons of self-control and responsibility, for owing to his mother's delicate health and his father's occupations, the care of his younger brothers and sisters devolved on himself and his sister Mathilde: in these younger days he also learnt tact, and his father taught him that difficulties had to be faced and overcome, and that duties must never be avoided.

In 1823, a few months after the birth of his brother William (whose lamented death occurred here nine years ago), the family removed to Menzendorf near Lübeck, in the Grand Duchy of Mecklenburg. In the Gymnasium of Lübeck Werner was educated up to his eighteenth year, when, by the advice of his father—who with rare prescience saw in Prussia the nucleus of German Unity and Empire—he went to Magdeburg to volunteer for service in the Prussian Army. For three years he studied in the Military School of Berlin, and in 1838 received his commission as a lieutenant in the artillery, and returned to Magdeburg; he was soon transferred to the Technical Division of the Artillery at Spandau, and afterwards to Berlin.

In July, 1839, his mother died, and six months afterwards his father; and then, at only twenty-three years of age, he became the veritable guardian of his younger brothers and sisters.

In 1842 he took out a patent in Prussia for electroplating and gilding, and having established a factory in Berlin for putting his invention into practice, he urged his brother William to devote his attention to the subject. This the younger brother did; and the story of his enterprise and success in this country then and ever since has been told by Dr. William Pole in his most interesting biography of him; to this volume and to the works of Dr. Werner von Siemens, the first volume of a translation of which has recently been published by Mr. Murray, we are indebted for much of the information contained in this short notice.

In 1844 the young artillery officer was appointed to the important post of Superintendent of the Artillery workshops, and in 1847 he became a member of the commission then instituted for introducing the electric telegraph into Prussia. Next year his military duties called him to Kiel, where in conjunction with his brother-in-law, Prof. Himly, he protected that port against the attack of the Danish fleet, by means of submerged mines connected with the shore by cables, at once the precursor of the submarine cable and the torpedo. In the summer of 1848, as commandant of Friederichsort, he built the fortifications for the protection of the harbour of Eckenförde, which afterwards became so celebrated. In the same year he was recalled to Berlin in order to erect a line of telegraph from Berlin to Frankfort-on-the-Maine, the first electric line laid in Germany, and with this his official military career terminated, and he devoted his attention altogether to those scientific discoveries and

inventions which have made the name of Siemens a household word in every region of the globe.

In 1874 Dr. Werner Siemens was elected a member of the Royal Academy of Sciences of Berlin, and the speech he made upon that occasion enables one to understand and appreciate his connexion with physical science. He was professionally connected with the application of science, which unfortunately left him but little leisure for those purely scientific investigations to which he always felt specially attracted. He says, to quote his own words in the speech just referred to, "My problems were generally prescribed by the demands of my profession, because the filling up of scientific voids which I met with presented itself as a technical necessity. I will only here mention cursorily my method of measuring high velocities by means of electric sparks, the discovery of the electrostatic charge of telegraph conductors and its laws, the deduction of methods and formulæ for testing underground and submarine cables, as well as for determining the position of faults occurring in their insulation, my experimental observations on electrostatic induction, and the retardation of the electric current thereby, the conception and realization of a reproducible basis of measurement for electrical resistance, the proof of the heating of the dielectric of a condenser by sudden discharge, the discovery and explanation of the dynamo electric machine. I think I may claim that many of my technical contributions are not without scientific value, among which I may mention the differential regulator, the manufacture of insulated conductors by pressing gutta-percha around them, telegraphic duplex, diplex, induction and automatic recording instruments, the ozone apparatus, and measuring instruments of different kinds. I had the honour of seeing these recognized by receiving from the Berlin University the distinction of Doctor of Philosophy, *honoris causa*."

The reply to this speech was made on behalf of the Berlin Academy by Prof. du Bois Reymond, the Secretary of the Physical and Mathematical Section, and some of the words he then spoke will show how Germany appreciated one of her ablest sons, one whom we also may claim, for when Werner Siemens was born, the King of England was Elector of Hanover. "By appropriating such a scientific form as yours, my dear Siemens, no Academy need be untrue to the laws of its foundation. Yours is the talent of mechanical discovery, which primitive people not improperly described as divine, and the cultivation of which constitutes the ascendancy of modern culture. Without having yourself worked with your hands in practical mechanics, you have reached the highest point in that art as creating and organizing head. With clear view and daring mind you soon grasped the great practical problems of electric telegraphy, and thus secured to Germany an advantage which Gauss, Wilhelm Weber, and Steinheil could not have procured for it. Your labours were for electricity what Frauenhofer's were for light, and you are the James Watt of electro-magnetism. Now you rule over a world which you created. Your telegraph lines surround the globe. Your cable ships navigate the ocean. Under the tents of nomads using bows and arrows, through whose hunting grounds your messages pass, your name is mentioned with superstitious awe."

This poetical description is fully justified by the great undertakings that have been carried out by the Siemens firm. The Indo-European telegraph, 2750 miles in length, passes across Europe, through a part of Russia to Tabreez and Teheran in Persia, and thence to India. But for the international character of the firm this work could probably never have been accomplished. But with Mr. Carl Siemens in St. Petersburg, Dr. Werner in Berlin, and Mr. William in London, to carry out the necessary negotiations, the tender was accepted in June, 1869, and the work was completed in December of the same year. Since then eighteen cables of a total length exceeding 21,000 miles have been constructed at their Woolwich works and laid in the Atlantic by the *Faraday*, by the firm of Messrs. Siemens Brothers and Co., Limited, of which firm Dr. Werner von Siemens was Chairman and Mr. Alexander Siemens is the Director in London.

In a single line of the speech just alluded to Dr. Werner refers to the dynamo machine. On this machine the whole supply of electricity for lighting, transmission of power, and other large purposes is dependent; and it is interesting in this connexion to note that the only rival to the electric light for large effects is the regenerative gas lamp invented by Dr. Werner's youngest brother, Mr. Frederick Siemens, the inventor, with Sir William Siemens, of the regenerative gas furnace.

Dr. von Siemens was a Knight of the Prussian order *pour le mérite*, an honour conferred only on those who have been distinguished for their services to science and industry. The honorary degree conferred upon him by the University of Berlin, and his membership of the

Royal Academy of Sciences of Berlin, have already been referred to. Dr. von Siemens was a member of many learned societies, and only in the spring of this year he was elected one of the sixteen honorary members of the Institution of Civil Engineers. The late Emperor Frederick III. of Germany conferred upon him the patent of nobility in 1888, and the present Emperor has expressed his sympathy with his sorrowing widow and family.

Dr. Siemens was unfortunately one of those attacked during the influenza epidemic, and although he recovered from it, it left him weak, and he has since been ailing more than once. A work on which he has been spending his spare moments was an autobiography, giving reminiscences of himself and of the firm of Siemens and Halske. This was published in Berlin a fortnight ago. On Tuesday, the 6th inst., Dr. Werner breathed his last at half-past six in the evening, just within a week of completing his seventy-sixth year. It may truly be said of him that, although he has passed from us, his life's labours will ever endure, having left an indelible mark on the world's progress.

The funeral took place on Saturday. The London, Belfort, Vienna, and St. Petersburg factories of the firm of which the deceased was a member, sent officials and workmen; the many thousands following the hearse, and the respectful attitude of the bystanders in the streets through which the funeral procession passed testifying to the regard in which he was held. The Emperor William was represented by Prince Leopold, the Empress Frederick by Count Seckendorff, and the German Empire by Chancellor Caprivi. Science and art and industry, the City of Berlin and the town of Charlottenburg were represented by deputies and deputations, all combining to do honour to one esteemed of all. E. F. B.

NOTES.

WE are glad to announce that Sir Archibald Geikie has undertaken to write the Life of Sir Andrew C. Ramsay, his predecessor in the Geological Survey. Sir Andrew Ramsay spent nearly the whole of his scientific career in the service, so that the record of his life and the story of the progress of the Survey are closely bound together. This is the third member of the staff of the Survey whose memoirs Sir Archibald Geikie will have written, the two others being Edward Forbes (whose Life he wrote in conjunction with the late Prof. George Wilson) and Sir Roderick Murchison. Sir Archibald joined the staff under Ramsay, and grew into the closest relations of friendship with him.

WE regret to have to record the death of Mr. H. T. Stainton, F.R.S. He died on December 2 at the age of seventy. He was indefatigable in his study of entomology, to which he made many important contributions. His chief work is "Natural History of the Tineina," in four languages, with many plates. His "Manual of British Butterflies and Moths" is also well known. Mr. Stainton was one of the founders of the *Entomologists' Monthly Magazine*, and remained to the end of his life one of its editors. He was for many years secretary of the Ray Society and of the Zoological Record Association, and one of the secretaries of Section D of the British Association. From 1848 he was a Fellow of the Entomological Society, of which he was at one time president; and from 1859 he was a Fellow of the Linnean Society, of which he was at one time vice-president. He was elected a Fellow of the Royal Society in 1867.

THE Chemical Society held a special meeting on Tuesday, the anniversary of the death of Stas. A paper, prepared for the occasion by Prof. J. W. Mallet, F.R.S., on "Jean Servais Stas, and the measurement of the relative masses of the atoms of the chemical elements," was read and discussed.

THE new Victoria buildings of University College, Liverpool, which include the Jubilee Tower, were formally opened on Tuesday. Lord Spencer, as Chancellor of the Victoria University, took part in the ceremony. At a banquet held in the evening, Mr. Bryce announced that the Queen, out of certain funds belonging to the Duchy of Lancaster, had been pleased to bestow upon the two great Lancashire Colleges a sum of £4000, to be applied in some permanent form, such as might be agreed upon by the authorities of the Colleges, particularly the principals, to commemorate the event of that day, and Her Majesty's interest in the growth of the institution.

ON Monday, at Merchant Taylors' Hall, Dr. William Anderson presented the prizes in connection with the City and Guilds of London Institute for the Advancement of Technical Education. Afterwards, addressing the students, Dr. Anderson called attention to the extraordinary advantages enjoyed by students of the present day in comparison with those within the reach of students of the past generation. In nearly all towns men and women were improving their knowledge in almost every branch of art and science to which their necessities or their inclinations led them. He had come to the conclusion that the aids given nowadays to manufactures and commerce were absolutely indispensable if England was to hold her own, and to overcome the difficulties which high-priced labour, the restrictions of the Legislature, and the interference of trade organizations imposed.

DR. T. JEFFREY PARKER, F.R.S., of Dunedin, Otago, New Zealand, who is now in this country, will read a paper on the cranial osteology, classification, and phylogeny of the Moas (Dinornithidæ) at the Zoological Society's meeting on the 14th of February.

THE committee appointed by the Board of Agriculture to inquire into the plague of field voles in Scotland have declined for the present to recommend the adoption of the plan lately carried out in Thessaly by Prof. Loeffler, who claims to have got rid of voles in that district by feeding them with prepared bait containing the germs of mouse typhus. It is thought that Prof. Loeffler may not have attached sufficient weight to other causes which have doubtless operated to reduce the swarms of voles in Thessaly, such as the heavy rains which on the low ground would flood the holes and runs of the mice. The chairman of the committee, Sir Herbert Maxwell, and the secretary, Mr. J. E. Harting, with the sanction of the Board of Agriculture and of the Treasury, are about to proceed to Thessaly for the purpose of taking evidence there and reporting.

A NEW edition of M. Alphonse Bertillon's important book on "Identification Anthropométrique" will be published in January. The book has been entirely recast and considerably enlarged. It is the result of ten years of observation, and has been prepared, not merely for the anthropometric service directed by the author, but for all who desire to have a proper comprehension of man's physical qualities. In addition to the copies intended for the use of the penal administration of the French Ministry of the Interior, a small number of copies will be reserved for persons who may desire to subscribe for them.

ON the evening of Thursday the 8th instant a deep barometric depression advanced upon our north-west coasts, and proceeded with considerable rapidity in a south-easterly direction, completely traversing Great Britain, as far as Dover, and travelling throughout its course at the rate of about 36 miles an hour. Its passage was accompanied by gales and by heavy rain or sleet, with severe snowstorms on the east coast. This disturbance passed away to the eastward, and was followed on Saturday by a fresh depression which appeared in the north-west, causing a strong gale in that district, and heavy squalls in most other parts. The changes of temperature were very irregular, the air being warm and moist under the influence of the cyclonic systems, but cold and relatively drier in the rear of the disturbances; in Scotland the frost was at times severe, the lowest of the minima being as low as 8° in the east of Scotland. In the early part of the present week a temporary improvement took place, with a generally rising barometer and falling thermometer, but these conditions soon gave place to a fresh disturbance in the north-west, accompanied by south-westerly winds generally. The *Weekly Weather Report* for the period ending the 10th instant showed that the temperature was below the mean in all districts, the greatest deficiency being about 7° over the northern parts of the kingdom. Rainfall exceeded the mean in the north-west of England and the north of Ireland, but in all other districts it differed little from the average amount. Bright sunshine was more prevalent than for many weeks past, except in the north of Scotland, where only 5 per cent. of the possible amount was registered.

A Foreign Office "Report on the Social and Economical Condition of the Canary Islands" (No. 246, 1892) contains some details with respect to the climate. There is no record of the freezing point having been touched at Laguna (Teneriffe), 1840 feet above the sea. At Vila Flor, also in Teneriffe, 4335 feet above the sea, the highest point where cultivation exists, the lowest temperature recorded in 1890–91 was 28°; the lowest reading at the sea level during the same period was 49°. The highest summer reading at Laguna was 104°·9 in 1885. The average maximum temperature near the sea in the summer is about 82°. The annual rainfall at Laguna is 29·4 inches, but at Santa Cruz (Teneriffe), at the sea level, it is only about 11 inches, and at Las Palmas it is as low as 8·4 inches. The greater part of the rain falls in the Monte Verde, where the vapour is carried from the sea by the trade wind. The rain generally begins early in October and ceases early in May.

The country between the Nile and the Red Sea has not always been so barren as it is to-day. There is ample evidence that in former times bodies of cavalry from three to five hundred in number ranged without commissariat difficulties over districts which are now deserts. The Arabic names of the valleys are names for trees, and there can be little doubt that at one time the valleys abounded with the trees after which they were called. How is the change to be explained? Much light is thrown on the problem by a most interesting paper printed in the new number of the *Kew Bulletin*, to which it has been communicated by Mr. E. A. Floyer, F.L.S., Inspector-General of Egyptian Telegraphs. It is an extract from the report (which will be published in French by the Egyptian Government) of the expedition despatched by the Khedive to this region in 1891. The writer believes that the mischief has been done during the last twelve hundred years, and that it is to be attributed to the Arab and his camel; the camel having eaten the leaves and shoots of the trees, the Arab having converted into charcoal the stem, root, and branch. The writer is inclined to state the matter thus: So long as the valleys were all the Arab had to depend on for feeding his camels, so long he preserved his trees for his camels. But by degrees some Arabs got a footing in the Nile Valley. They hired their camels to the farmer to carry their harvest. They went back to their deserted valley and brought away the trees in form of charcoal. Thus the land was gradually made bare. If this explanation is correct—and there is evidently much to be said for it—the writer points out that a like cause may be invoked over large areas to explain, for example, the disappearance of the frankincense and spices from Southern Arabia, to explain the thousands of chariots and horsemen in Palestine, and to explain how in early times a greater fertility and population existed in many countries whose history, like that of Palestine, seems out of proportion to their present circumstances. It is a pity, by the way, that in so good a paper nature should be spoken of as having produced in the camel "a Frankenstein." Frankenstein in the story was not the monster, but the monster's creator.

It is by no means certain that the harm which the camel is capable of doing in Egyptian territory has even yet been exhausted. The writer of the report considers it possible that the prosperity in Egypt in which all Englishmen are rejoicing may seal the destruction of the remaining trees, and leave the country bare save of *Calotropis procera* and the plants which nourish a few sheep and donkeys, attended by herdsmen, fed by grain from the Nile Valley. "The camel," he says, "will then, having so to speak burnt its boats, be domesticated in the Nile Valley. And it is interesting to speculate as to how he will develop there. Already the massive Cairo camel is a type distinct from other camels, surpassing all in its cumbrous massive proportions."

The December number of the *Kew Bulletin* contains, besides the paper on the disappearance of desert plants in Egypt, interesting sections on the Taj Gardens, Agra; Indian gutta-percha; the Gold Coast botanical station; Ramie machine trials at New Orleans; Lord Bute's "Botanical Tables"; and miscellaneous notes. Reference was made to the "Botanical Tables" in the historical account of Kew, printed in the *Bulletin* in 1891, p. 291. Since that was written the authorities at the Royal Gardens have had an opportunity, through the gracious permission of the Queen, of examining the copy in the Royal Library at Windsor, which formerly belonged to Queen Charlotte, to whom the work was dedicated. On the fly-leaf of the first volume of the Windsor copy is the following note in pencil, written by the Rev. John Glover (appointed Royal Librarian by William IV.):—"Of this work only sixteen copies were printed for presents, at a cost, it is said, of more than £10,000. This copy belonged to Queen Charlotte, and was purchased at the sale of Her Majesty's Library for, I believe, £100." There seem, however, to have been only twelve copies. The general nature of the contents is indicated in the *Bulletin*. There are nine volumes, and the work contains 654 plates, all of them apparently drawn and engraved by John Miller, an excellent German artist—Johann Sebastian Mueller, who thus anglicised his name.

Ceylon is sending to the Chicago Exhibition a complete reproduction of a Buddhist temple and many interesting specimens of ancient Sinhalese art, including, according to the *Ceylon Observer*, "exquisitely-carved pillars, massive doorways and dados, beautiful windows and frescoed panellings of courts." There will also be, among other things, a display of jewellery, lace, and pottery. It is hoped that these treasures will do something to further in America "the interests of the most modern product of Ceylon, tea."

At the recent meeting of the Congress of Americanists at Huelva, Mrs. Zelia Nuttall, of the Peabody Museum of American Archæology and Ethnology, Cambridge, Massachusetts, presented a preliminary note on the calendar system of the ancient Aztecs. Guided by a statement in a Hispano-Mexican MS. which she has recently discovered in the National Central Library of Florence, Mrs. Nuttall claims to have found the key to the Aztec calendar system. She exhibited tables showing that the Mexican cycle was 13,515 days, and that it comprised 52 ritual years (less five days at the end of the cycle), of 260 days each, or 51 lunar years of 265 days each, based on nine moons, or 37 solar years each of 365 days. At the end of the fifty-first lunar year 10 intercalary days placed the solar years in agreement with the lunar years in such a manner that the new cycle recommenced in the same solar and lunar positions as the 13,515 preceding days. Each period commenced with a day bearing one of the four names: *acatl*, *tecpatl*, *calli*, *tochtli*. The calendar system and tables, 14 metres long, designed to illustrate this communication, were subsequently placed on exhibition in the Spanish section of the Historical Exhibition at Madrid. Her Majesty the Queen of Spain commanded that Mrs. Zelia Nuttall should be presented to her, and expressed much interest in her work.

No one expects to see the corncrake in Great Britain after the summer months. According to the *Llangollen Advertiser*, a specimen was caught last Thursday in the neighbourhood of Pentrefelin, Llangollen. Several local naturalists have seen the bird, and agree that it is a corncrake.

A NEW luminous fungus has been forwarded to Europe from Tahiti. It is said to emit, at night, a light resembling that of the glowworm, which it retains for a period of twenty-four hours after having been gathered, and it is used, by the native women, in bouquets of flowers for personal adornment in the hair and dress. It belongs to the section "dimidiati" of the genus *Pleurotus*, in which no luminous species has been hitherto known, although there are several in the genus, and has been named by M. Hariot *Pleurotus lux*. It is believed to grow on the trunks of trees.

A THEORETICAL investigation of the conditions under which Lippmann's coloured photographs are produced is given by M. G. Meslin in the *Ann. de Chim. et de Phys.* for November. He maintains that the colours produced are complex, and belong to the higher orders of Newton's scale. This is illustrated by the change in colour observed when the thickness of the film increases. When moist air is blown upon it the film swells, and the bright colours give way to others consisting principally of red and green. The impure nature of the spectrum ordinarily obtained would account for its "metallic" appearance. Besides, there is a blue or greenish-blue region which extends beyond the red end of the spectrum. The composite nature of the colours reflected from the surface of the spectrum photograph may be shown by projecting a similar spectrum upon the film. The colours will then appear very brilliant. But if, for instance, the green is projected upon the red of the film, green is reflected all the same, although less distinctly than before. The same thing happens in other parts of the spectrum. On moving it from the violet towards the red, the violet, arriving at the green portion, is interrupted by a broad band. On further displacement this band, the breadth of which is about equal to the distance between the E and the b lines, moves through the green and yellow and reaches the red. At this moment the blue and violet regions show the greatest brightness. There is only one band observed throughout. This observation is in accordance with the thickness attributed to the layers, viz. between 200 and $350\mu\mu$. Hence the paths traversed by the light will range from $400\mu\mu$ to $700\mu\mu$, giving $\frac{\lambda}{2}$ for none of the colours, $\frac{3}{2}\frac{\lambda}{2} = 600\mu\mu$ for the violet, $650\mu\mu$ for the blue, and $700\mu\mu$ for the green. It will be still greater, *i.e.* $\frac{3}{2}\frac{\lambda}{2}$ for the red, in the infra-red region of the spectrum. There we shall have a black band in the red, while the blue is at its maximum, owing to the retardation being equal to two wave-lengths. Hence the blue region beyond the red corresponds to the infra-red region of the incident spectrum, which in long exposures is able to produce a photographic effect.

DURING the year 1891 about 450 more persons were killed by wild beasts in India than during the preceding year. The number in 1890, however, was abnormally low, and the *Pioneer Mail* calculates that last year's figures were about 250 in excess of the mean. In one district of Bengal—Hazaribagh—no fewer than 205 deaths were due to a single brood of man-eating tigers. The yearly average of persons destroyed by wild beasts in our Eastern dependency is between 2500 and 3000. The mortality from snake-bite is on a much larger scale. Year by year it varies from something over 21,000 to something over 22,000.

AN excellent account of the Experiment Stations established in the United States in the interest of agriculture is given by Mr. R. Warington, F.R.S., in a paper issued by the National Association for the Promotion of Technical and Secondary Education. A fully equipped Experiment Station, he says, is a large and costly piece of machinery, embracing many departments of work. There is one in every State of the Union, and in some States there are more than one; the total number is fifty-four. These Stations are endowed by Congress, £3000 a year being paid to the Station or Stations of each State. If the income derived from the State Legislatures, and from other sources, be included, the average income of each Station is nearly £4000. In nearly every instance the station is connected with the States Agricultural College, and the Station buildings are in its immediate vicinity. The publications of the Stations are made in the form of periodical bulletins and annual reports; for the printing of these a special grant is made by the State, and they are distributed by the Federal Government post free. The issues are very large: 60,000 copies of each Station bulletin are printed in Ohio. Any farmer in the State can at his request receive the bulletins regularly without payment. Mr. Warington expresses a hope that our own County Councils may be encouraged to try to do for agriculture in Great Britain what is so energetically done for it in America by the various States.

A SERIES of investigations on soils is in progress at the Maryland Agricultural Experiment Station, in co-operation with the U.S. Department of Agriculture and the Johns Hopkins University. So far the work has been on the physical structure of the soil and its relation to the circulation of soil water, and the physical effect of fertilizers on soils as related to crop production. The surface tension of various solutions was first of all determined. The solutions chosen included common salt, kainit, superphosphate of lime, soil extract, and ammonia. The soil extract was made by shaking up a little soil with just sufficient water to cover it. The water was afterwards filtered off and used for the determination. This operation reduced the surface-tension of water considerably, but the experiments do not appear sufficiently complete to indicate reasons for this. Analyses of the soils are not given. Ammonia and urine lowered the surface-tension of water considerably below that of the soil extract, and still more below that of pure water. Common salt and kainit increase the surface tension of water, and no doubt this is the reason why the application of these substances to the soil tends to keep it moist, whereas the excessive use of nitrogenous manure has the reverse effect.

THE Chamber of Commerce at Reims has published the statistics of the trade in champagne since 1844. In 1844-45 the value of the trade was 6,635,000 francs, and in the following year it exceeded seven millions. In 1868-69 it amounted to nearly sixteen millions, but fell to nine millions in 1870-71, and then rose in 1871-72 to twenty millions. The value in 1872-73 was twenty-two millions, and it oscillated between this sum and seventeen millions until 1889-90, when it became twenty-three millions. The figures were 25,776,000 in 1890-91; 24,243,996 in 1891-92. The number of bottles used in France rose from 2,225,000 in 1844-45 to 4,558,000 in 1891-92, while the number exported rose during the same period from 4,380,000 to 16,685,900. The year in which most bottles were sent abroad was 1890-91 (nearly twenty-two millions).

MESSRS. SWAN, SONNENSCHEIN AND CO. have issued a translation, by Dr. E. L. Mark, Professor of Anatomy in Harvard University, of the third edition of Dr. Oscar Hertwig's

"Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere." The volume is entitled "Text-Book of the Embryology of Man and Mammals." The translator, in his preface, expresses his belief that the work "covers the field of vertebrate embryology in a more complete and satisfactory way than any book hitherto published in English."

THE latest instalment of the Proceedings of the Academy of Natural Sciences of Philadelphia contains a valuable paper, by Prof. E. D. Cope, on the Batrachia and Reptilia of North Western Texas. The statements presented in the paper are based on collections made along the eastern border of the Staked Plain of Texas, between Big Spring (on the Texas Pacific R. R.) on the south, and the Salt Fork of the Red River, near Clarendon (on the Denver and Fort Worth R. R.) on the north, a distance of about 250 miles. The collections were made incidentally to geological and palæontological explorations conducted by a party of the Geological Survey of Texas, which was under the direction of Mr. William F. Cummins. While attached to this party Prof. Cope picked up such specimens as came in his way, and a good many others were obtained by Mr. Cummins and by Mr. William L. Black of the party. The total number of species enumerated is thirty-three. The paper may be regarded as supplementary to one published as Bulletin 17 of the U.S. National Museum in 1880, on the Zoological position of Texas.

THE following are the lecture arrangements at the Royal Institution before Easter:—Sir Robert Stawell Ball, six lectures (adapted to a juvenile auditory) on astronomy; Prof. Victor Horsley, ten lectures on the brain; the Rev. Canon Ainger, three lectures on Tennyson; Prof. Patrick Geddes, four lectures on the factors of organic evolution; the Rev. Augustus Jessopp, three lectures on the great revival—a study in mediæval history; Prof. C. Hubert H. Parry, four lectures on expression and design in music (with musical illustrations); the Right Hon. Lord Rayleigh, six lectures on sound and vibrations. The Friday evening meetings will begin on January 20, when a discourse will be given by Prof. Dewar on liquid atmospheric air; succeeding discourses will probably be given by Mr. Francis Galton, Mr. Alexander Siemens, Prof. Charles Stewart, Prof. A. H. Church, Mr. Edward Hopkinson, Mr. George Simonds, Sir Herbert Maxwell, Bart., the Right Hon. Lord Rayleigh, and other gentlemen.

THE micro-organism which has been shown to be the exciting cause of tetanus or lockjaw is just now especially attracting the attention of bacteriological investigators. Kitasato, who it will be remembered was the first who successfully isolated the bacillus of tetanus, has been continuing his researches on the protective inoculation of animals against this malady. In the current number of the *Zeitschrift für Hygiene* appears an account of some extremely interesting results which he has obtained with mice and guinea-pigs. In his experiments Kitasato introduced subcutaneously into these animals small splinters of wood which had been previously soaked in bouillon-cultures of tetanus, so prepared that only the spores were present. He wished in this way to imitate as nearly as possible the actual manner in which tetanus is communicated, and which in consequence of the sensitiveness of the bacillar form to heat and light and the extremely refractory nature of the spores, is almost invariably due to the accidental introduction of the latter. This theory is also supported by the fact that between the infliction of the wound and the development of symptoms of tetanus there is invariably a distinct lapse of time, during which the spores grow into bacilli and elaborate their toxic products within the system of the animal affected, after which the typical appearances of tetanus arise. The protective material used in these investigations was the serum of a horse artificially rendered immune against tetanus, and in every case out of those mice which had received a small wood-splinter two were put aside and not subsequently inoculated with the protective serum. Kitasato found, as he had expected, that a definite period of time elapsed between the introduction of the splinter and the development of tetanus symptoms; but with hardly an exception, all those mice subsequently treated with the serum recovered, whilst those which had received no protective treatment died exhibiting the typical characteristics of tetanus. Moreover, it was found that the earlier the application of the serum took place after the infection and quite irrespective of the appearance of any signs of tetanus, the more successful was the result and the smaller the dose of serum necessary, whilst when the wood-splinters and the serum were introduced together no symptoms whatever of tetanus declared themselves. The same successful results were obtained in the case of guinea-pigs. In connection with the excessively hardy nature of the spore-form of tetanus, Hervieux (*Ann. de la Soc. méd-chir. de Liége*, 1891) has found that even after eleven years such spores still retain their power for mischief. A small fragment of wood was extracted from the ankle of a child who had died of tetanus, and after being kept for nearly eleven years part of it was introduced under the skin of a rabbit, which afterwards died of tetanus. The infection was further confirmed by the discovery of tetanus bacilli in the pus of the wound.

THE chloraurates and bromaurates of cæsium and rubidium have been prepared by Messrs. Wells and Wheeler, and are described in the current number of the *Zeitschrift für Anorganische Chemie*. They are all four beautifully crystalline substances. The crystals, which have been measured by Mr. Penfield, belong to the monoclinic system, and form an isomorphous series of identical habitus. These salts are so comparatively insoluble in water that they are obtained in the form of crystalline precipitates when concentrated solutions of chlorides or bromides of cæsium or rubidium are mixed with strong solutions of chloride or bromide of gold. They are, however, sufficiently soluble to admit of recrystallization from water. The crystals of cæsium chloraurate, $CsAuCl_4$, exhibit an orange-yellow colour; those of the corresponding rubidium salt, $RbAuCl_4$, possess a more deeply orange tint; while the two bromides, $CsAuBr_4$ and $RbAuBr_4$, are jet-black but yield a dark red powder upon pulverization. The cæsium compounds are much less soluble than the rubidium ones, so that the crystals are usually much smaller. The more soluble rubidium salts readily form very large crystals; the chloride in particular yields crystals whose size appears only to be limited by that of the crystallizing vessel and the depth of the solution. The crystals, however, whether large or small, all partake of the same character; they are elongated prisms terminated by the basal plane, orthodome, clinodome, and small pyramidal planes. The faces are usually extremely brilliant, but those of the bromides are often singularly hollow or cavernous. In addition to this well-defined series, another chloraurate of cæsium has been obtained containing water of crystallization. This salt, $2CsAuCl_4.H_2O$, is formed when a large excess of gold chloride is present compared with the amount of cæsium chloride. It separates in the form of light orange-coloured tabular crystals belonging to the rhombic system, which exhibit the peculiar property of undergoing an internal change accompanied by elimination of the water of crystallization, within a few minutes of their removal from the mother liquor. The change is probably due to the passage of this hydrated salt into the relatively more stable anhydrous chloraurate described above. It betrays itself in a most interesting manner under the microscope, in polarized light. When a crystal plate is removed from the mother liquor, rapidly dried by means of blotting-paper and placed under the microscope, the Nicols being crossed, it simply produces the usual effect of causing the field to become coloured with some homogeneous tint. But after the expiration of three or four minutes the molecular change begins to be rendered apparent at the circumference of the field by a rapid augmentation of the polarizing effect; in another moment it commences to dart across the field in all directions, the brilliantly coloured rays being feathered with offshoots, reminding one of the rays of crystallizing ammonium chloride. This beautiful effect continues until, in less than ten minutes after the removal of the crystal from the mother liquor, the rearrangement of the molecules has become so general that light is no longer able to penetrate, and the crystal becomes completely opaque. Messrs. Wells and Wheeler have also attempted to prepare the analogous compounds containing iodine, but have not yet obtained them in a condition so pure or well crystallized as the salts described above.

THE additions to the Zoological Society's Gardens during the past week include a white-fronted lemur (*Lemur albifrons* ♀) from Madagascar, presented by Mr. M. C. Parker; a brown capuchin (*Cebus fatuellus* ♂) from Brazil, presented by Mr. Earle Tudor Johnson; a large-eared fox (*Otocyon megalotis*) from Mashonoland, South Africa, presented by Mr. B. B. Weil; two black-backed jackals (*Canis mesomelas*) from South Africa, presented by Capt. Ralph H. Carr-Ellison; a common fox (*Canis vulpes* ♀) from Arabia, presented by Miss Morgan; a leadbeater's cockatoo (*Cacatua leadbeateri*) from Australia, presented by Lieut.-Colonel Warton; a Rhesus monkey (*Macacus rhesus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES (NOVEMBER 6).—The following is the ephemeris for Comet Holmes for the ensuing week:—

1892.	R.A. (app.). h. m. s.	Decl. (app.). ° ′	Log *r*.	Log Δ.
Dec. 15	0 49 34	+34 50·1		
16	50 15	45·8	0·4004	0·2813
17	50 57	41·6		
18	51 41	37·5		
19	52 27	33·6		
20	53 14	29·8	0·4027	0·2931
21	54 3	26·1		
22	0 54 53	+34 22·6		

Owing to the extremely bad weather, observations of this comet have not been numerous, but from all accounts not much change has taken place in the general appearance, except that the central nucleus seems to possess two small tails, which extend towards the ragged edge of the exterior portion.

COMET BROOKS (NOVEMBER 20, 1892).—Last week the only ephemeris of this comet at hand was one showing its position every fourth day, but Prof. Kreutz has now communicated to *Astronomische Nachrichten*, No. 3132, a daily ephemeris, from which the following is extracted:—

1892.	R.A. (app.). h. m. s.	Decl. (app.). ° ′	Log *r*.	Log Δ.	Br.
Dec. 15	13 50 10	+31 57·3			
16	54 6	33 17·2	0·0974	0·0001	3·67
17	13 58 19	34 41·2			
18	14 2 53	36 9·5	0·0946	9·9775	4·13
19	7 51	37 42·2			
20	13 17	39 19·3	0·0921	9·9550	4·63
21	19 13	41 0·8			
22	25 46	42 46·6	0·0898	9·9332	5·17

From the column showing the brightnesses it will be seen that a considerable increase in this comet is taking place. The comet will be easily found by the fact that it lies in the prolongation of a line joining β and γ Bootis (December 18) at a distance equal to that between those two stars.

THE NEW BROOKS' COMET.—The following positions of this comet are reported from Marseilles, by MM. Esmiol and Fabry:—

Date.	Marseille Mean Time. h. m. s.	App. R.A. h. m. s.	App. P.D. ° ′ ″
Nov. 24	17 45 16	13 3 14·6	74 51 33
24	17 6 53	13 4 39·39	74 33 18·1
29	16 43 46	13 11 1·76	72 11 46·7
30	16 41 49	13 12 45·77	71 34 49·0

The comet presented the appearance of a nebulosity about 1′ in diameter, diffuse at the edges, and brighter towards the centre, but without a well-defined nucleus. Its brightness was about that of a star of eleventh magnitude.

NOVA AURIGÆ.—Nova Aurigæ has again increased in magnitude, observations showing that visibly it is 8·5, while photographically it is three magnitudes fainter.

ASTRONOMY AT COLUMBIA COLLEGE, U.S.A.—The latest number of the bulletin issued by this college informs us that with the consent of the governing body of the New York Hospital and the college trustees, a new but small observatory is about to be erected on the site Bloomingdale. The instrument, which is at present being constructed by Wauschaff, at Berlin, is a zenith telescope, and it is one of a pair which is going to be used for observations to obtain accurate determinations of the variations of terrestrial latitudes. The other instrument, by order of the Italian government, is going to be mounted at the Royal Observatory of Capodimonte. Both instruments will soon be, if not already, in working order; the observers in America are Prof. Rees and Mr. Jacoby, while M. Higola will undertake the Italian observations.

The library of this college has been recently very much increased by the purchase of the fine library of astronomical and physical works belonging to Mr. Struve, former director of the Pulkowa observatory. This addition amounts to no less than 4361 bound and unbound books, together with 3056 pamphlets.

COMPANION TO THE OBSERVATORY FOR 1893.—This annual *Companion* for the coming year is very similar to the one last published. Mr. Denning gives a list of the principal meteor showers deduced from recent observations, while ephemerides for the planets, together with their satellites, are also inserted. Solar observers will find the ephemeris given on page 22 very useful, this table giving the position-angle of the sun's axis, and the heliographic latitudes and longitudes of the centre of his disc. In addition to several other handy tables and ephemerides, the times of minima of variable stars not of the Algol type, variable stars of the Algol type, maxima and minima of variable stars, and finally a table of double stars are also included.

GEOGRAPHICAL NOTES.

MAJOR THYS, who has recently returned from the Congo Free State, reports that the railway from Matadi to Stanley Pool is progressing rapidly. The works are practically completed for only 14 kilometers out of the 400, but this includes the most difficult region, including the greater part of the ascent to the plateau. In a few months it is hoped that 40 kilometers will be completed, and the malarial coast-belt can then be traversed rapidly, obviating a serious risk to the health of travellers to the Upper Congo.

WE are pleased to find that the Manchester Geographical Society has published the concluding part of the seventh volume of its Journal although, as we had occasion to remark on the appearance of the previous part, it is greatly to be regretted that the people of Manchester do not take a greater interest in a Society which is one they have reason to be proud of. It is, we are convinced, solely to this want of local appreciation that the Journal has to be issued so far behind its proper date as to impair the usefulness of its contents. In the current number there is an interesting paper on Japan by Mr. W. M. Steinthal.

MR. G. A. CRAIG has, we understand, resigned the secretaryship of the Liverpool Geographical Society on account of ill-health.

THE *Scottish Geographical Magazine* for this month contains a paper by Captain Lugard, entitled "Characteristics of African

Travel." The Society presented Capt. Lugard with its silver medal and an honorary diploma of Fellowship. A similar award has been made to Mr. Joseph Thomson in recognition of his services to Geography in Africa.

DR. J. TROLL, an Austrian explorer, is at present engaged in a journey through Central Asia. He reached Samarkand in the end of October. Thence he proposes to pass through Russian and Chinese Turkestan and Mongolia, intending to return by Pekin and Shanghai. In the course of his journey he hopes to visit the ruined city of Karakoram, the ancient capital of Jenghiz Khan.

A RAILWAY has recently been opened from Wiborg, in Finland, to the Imatra Falls, thus bringing the finest rapids in Europe within six hours of St. Petersburg. Hitherto the falls have been reached by canal-steamer and coach, the journey occupying not much less than twelve hours.

MR. JOSEPH THOMSON proposes to use the name "Livingstonia" to describe the whole British sphere of influence north of the Zambesi and west of Lake Nyasa. It is little to the credit of British cartographers that the attempts hitherto made to associate Livingstone's name with the continent of which he was the greatest explorer have practically failed.

THE DESTRUCTION OF IMMATURE FISH.

MR. ERNEST W. L. HOLT contributes to the new number of the Marine Biological Association's Journal another very interesting paper on the results of his North Sea Investigations. He has much to say as to the destruction of immature fish in the North Sea, and makes the following observations on proposed remedial measures :—

It will be admitted that the continued destruction of large numbers of valuable fish before they have had a chance of reproducing their species can only result in increased deterioration of the industry, and that some measures must be taken to put a stop to it, unless we are prepared, and able, by artificial propagation to restock the sea as fast as we deplete it. Briefly the various proposals that have been put forward fall under three headings, viz. closure of grounds frequented by small fish, restriction of sale of undersized fish, and enlargement or alteration of mesh. We have seen that some of the smack-owners have adopted the eminently practical method of forbidding their boats to fish where they are likely to catch much small stuff; but the buyers, though as loud as any in their outcry, do not appear inclined to avail themselves of their undoubted power to check the evil. The proposals for legislative action have been so much discussed of late that I need only advert to such as affect the North Sea district.

It is a matter of common knowledge that the bulk of the destruction by deep-sea trawlers takes place on the eastern grounds, to which I have alluded elsewhere ; and since these lie wholly or in part outside the three-mile limit, it has been proposed that they shall be closed to trawling by international agreement. Whether such agreement could ever be arrived at is questionable and if it were, it is not likely that the ensuing legislation could be easily enforced. The great extent of the grounds would involve an enormous and costly Marine Police force, of mixed nationality ; and even were such a body much more efficient than one has any reason to expect, there might be considerable difficulty in adequately watching grounds which extend in some cases over fifty miles from shore. Indeed, on our own coasts and elsewhere the success with which legislation limited to the territorial area has hitherto been enforced is hardly such as to encourage us to extend the principle to the open sea.

The various standards of size which have been advocated, in proposals for prohibiting the sale or possession of undersized fish, differ according as the subject has been treated with regard to the marketable qualities of the fish, or to its powers of reproduction ; and it may be assumed, I suppose, without argument that the latter is the more rational method of treatment. Still it may be as well to recapitulate the sizes proposed at the Fishery Conference at Fishmongers' Hall last February, since they may be taken to represent the most recent trade opinion on the subject.

They are for turbot and brill twelve inches, for soles and lemon sole (*Pleuronectes microcephalus*) ten inches, and for plaice eleven inches. How far they fall short of the biological limits, at least for the North Sea district, can be judged by comparing them with the table of sizes on p. 384 of the Journal ; and, indeed, I may remark that the prohibition of the sale of turbot and brill under twelve inches in length is rather a work of supererogation, since the number of smaller fish of these species that come to market, at all events at Grimsby, is utterly insignificant.

The benefit to be expected from any measure of prohibition depends of course on the vitality of the fish, and it is very generally asserted that the bulk of the small fish trawled on these eastern grounds would not survive if returned. My own experience leads me to believe that this view is correct[1] so long as the present system of long hauls is maintained. Hence we must seek for such a limit as will render the grounds most frequented by these small fish unprofitable to the fishermen (since any less limit would only involve an infinitely greater waste than takes place at present), and in doing so it is necessary to glance at the general conditions of this fishery.

Exclusive of less important forms, the species chiefly met with are plaice, turbot, and soles. The plaice, on most grounds, do not exceed a length of fifteen inches, and are mostly less than thirteen inches in length. The turbot are fairly abundant, but, as I have already shown, almost all immature ; soles are scarce. It is only the certainty of being able to fill up with small plaice that induces the fishermen to cross to the eastern side, since the soles and turbot would not nearly pay his expenses by themselves. Now I am confident that if the Conference limit of eleven inches for plaice were enforced, there would still be enough saleable fish left to make the grounds worth visiting, whereas if it were raised to fifteen or even fourteen inches the grounds would assuredly be left alone ; and although such would be below the biological limit, I believe the practical closing to our huge fleets of such a magnificent nursery for young plaice would be in itself a sufficient protection for the species. Certain rough patches of ground, practically surrounded by areas yielding only small fish, abound with only large fish ; these would still be accessible to fishermen, whereas in any scheme of geographical restriction it would hardly be possible to exempt them. Moreover the restriction of size would probably do away with the destruction of small plaice by shrimp or sole-trawls, since the fish are not injured by being caught in these nets, and if unsaleable[2] would probably be returned.

For turbot, brill, and sole I would advocate the adoption of the biological standards. They are all rather hardy forms, and it appears that immature brill and such immature turbot as are found on our own coasts are chiefly caught on certain banks where the intricate nature of the ground renders short hauls a necessity, so that they could be returned to the sea in good condition, as indeed the smaller of them usually are at present by many fishermen. With regard to soles, I do not think that many undersized fish are caught by deep-sea trawlers,[3] and the substitution of a size limit for the present prohibition of the use of a fish-trawl in the Humber would do away with the anomaly of a law which is not enforced. There is a strong feeling amongst inshore fishermen that the bye-law alluded to is unequal in its operation, since it offers no check to the destruction of small fish on off-shore grounds, only accessible to large boats. Hence a regulation as to the size of fish landed is perhaps preferable to one based solely on territorial conditions somewhat imperfectly understood.

An objection which I have heard urged against any scheme for keeping our trawlers off the eastern grounds is that the summer sole trade in the North Sea would thereby be left entirely in the hands of foreigners. I think that this is, perhaps, rather overstating the case, but anyhow I cannot see that it furnishes any excuse for the present enormous destruction of small plaice and turbot, whilst it is at least possible that the abstention of our own fleet from these grounds in the summer would result in a corresponding increase in the number of soles in the localities where that species congregates in the winter months. I have no knowledge of the migrations of soles, but the Great Silver Pit is equidistant from the Humber and the nearest eastern ground, and as it is the nearest point at which similar physical conditions can be attained, it does not seem improbable that the winter supply of soles in the Pit is in part recruited from the east side of the North Sea.

[1] Owing to the great mass of fish caught in a single haul, I consider it quite possible to hold this view without throwing any doubt on the value of the results obtained by my friend Dr. Fulton in his experiments on the vitality of trawled fish (Report S F. B., 1891).

[2] The possession, as well as the sale, should be prohibited, to guard agains the possible danger of small fish being utilized as manure when the fisherman is also a farmer in a small way.

[3] The small soles caught on the Dogger and on the Dowsing are really solanettes (*Solea minuta*).

Another objection is that boats of British nationality are not the only ones engaged in the small fish trade, and it is true that during the summer months a number of German, Dutch, and Danish boats are occupied in catching small plaice. But they are all of small tonnage, some of them only open boats; and I understand that from the manner in which the trawl is handled by German and Danish boats no injury is done to the unmarketable fish, whilst the saleable part of the catch appears to be exported chiefly to London. Hence the proposed measures of prohibition would give no advantage to these nations. The German steam trawlers, according to my information, do not molest the small plaice at all. Of the proceedings of the Dutch bombs I have little knowledge, but from the small size of their gear, their share in the destruction cannot be a very large one. Foreign-caught fish, except Norwegian salmon and mackerel and Dutch soles, including only a small percentage of undersized fish, rarely come to the Grimsby market, but on two occasions large consignments of small plaice, comprising, as I compute, some 31,000 fish, were sent from Denmark, and recently a consignment of turbot has arrived from Norway. These last fish were about 300 in number, all undersized, viz. from $9\frac{1}{2}$ to 17 inches, whilst 4 were only from 8 to 9 inches. This is the only instance which has come under my notice of any considerable number of turbot less than 12 inches being present in the market, and, as we have seen, our own fishermen were not concerned in it.

The last and perhaps the most important objection arises from the difficulty in allowing for that variation in the size of fish of the same species on different parts of our own coast to which Mr. Calderwood alluded in the last number of the Journal, p. 208. The impossibility of utilizing a uniform size limit for all districts sufficiently exemplified by the limit of 11 inches for the plaice proposed by the Conference of last February, which was the result of a compromise between the trade representatives of the North Sea and south and west coast districts. While perhaps unnecessarily high for the Plymouth district, we have seen that it is altogether too small for the North Sea. The difficulty of having different limits, of local application, will only be felt at such a central port or market as London, to which fish are brought, whether by rail or sea, from all districts, but with proper organization the obstacle does not seem insuperable. It is conceivable that the law might be evaded by running cutters from boats fishing in one district to the parts of another, where the limit was lower, but it is little likely that the firms which are in a position to undertake them, would lend themselves to such operations. There is not the slightest reason to apprehend a general conspiracy of evasion amongst the fishermen, and the boats which respected the law would form a more efficient police than all the cruisers in the navy, so far as one may judge by the conditions on the Scotch coast, where convictions of trawlers for infringement of the territorial restriction are frequently secured by the evidence of local line fishermen.

I must leave to others, who are acquainted with the local conditions, to decide whether the imposition of a size limit is desirable in other districts, but for the North Sea I have not the slightest hesitation in recommending this method of legislation, in the terms I have proposed above, as cheaper and likely to be infinitely more efficacious than any other that can be devised in maintaining the supply of the more important kinds of flat-fish. I need hardly observe that its application to the halibut, which is chiefly a line fish, could not fail to be beneficial to that species, since there is no question but that fish caught on the hook will usually survive if returned;[1] but I do not think that the limit need be as high as the biological one, owing to the difference in the conditions of the trawl and line fisheries.

I am not prepared to enter at present into the question of mesh legislation, beyond pointing out that it appears to be the only method by which the destruction of immature round fish, notably haddock and whiting, can be checked, since these species are fatally injured by being caught in the trawl, and would not survive if returned. Any great enlargement of the mesh does not appear advisable, since it would afford an opportunity of escape to the mature sole, of which that active species would be extremely likely to avail itself. The remedy seems to lie rather in an alteration of the arrangement of the meshes in the cod-ends, so as to prevent them from closing. On this subject I have been making investigations, but they are not yet sufficiently complete to yield reliable deductions. It is sufficiently evident, as has often been pointed out, that the great breadth of some of the flat-fish render it impossible to deal with the whole question by restrictions of mesh alone.

[1] Except fish with air-bladders, caught at considerable depths.

The last matter with which I have to deal is the destruction of very small fish by shove-net and shrimp "seines." If it were only possible to induce the men to cull out the small fish in the water they would do no harm at all, and practically I suppose that, as matters are, they do not greatly injure any species of known value except the plaice, although the small number of sole, turbot, and brill destroyed may represent, from the relative scarcity of these species, a more considerable injury than one would suppose. When fishing by day the shove-net men usually return the fish to the sea, but by night this is impossible, and the seine men do not seem to make any effort in that direction either by day or night.

It is a difficult question to deal with, since the shrimp appears to be almost a necessity to some people; at the same time the small plaice which are destroyed must represent an infinitely greater value than the shrimps. If hatcheries were established, and young turbot, brill, sole, and plaice were enlarged after they had been reared through the delicate larval and metamorphosing stages, it is reasonable to suppose that they would be conveyed or would find their way to the sandy margins, which seem best adapted to the succeeding stages of their life-history, only to fall into the net of the shrimper.

I should say that to prohibit the use of any sort of shore shrimp nets during night-time would be a beneficial measure, but there is perhaps sufficient reason for abolishing the industry altogether. Those engaged in it might be sufficiently compensated at a moderate expenditure, if indeed it be not contrary to public policy to admit the existence of a vested interest in an occupation which is essentially injurious to industries affecting a much greater section of the community.

THE NEW TELEPHOTOGRAPHIC LENS.

IN a small pamphlet of thirty pages, written and published by Mr. T. R. Dallmeyer, the author brings together the various notices bearing on the subject of his new telephotographic lens that have appeared during the last twelve months. He also gives an account of the "simple" and "compound" telephotographic lens, with general instructions for their use, including tables of their properties, and a table showing the diameters of circles of illumination necessary to cover the various sized plates used at the present day.

The telephotographic lens is, we may say, the latest advance made in the science of optics as applied to photography. By it we are now able to obtain large pictures of animate things situated at long distances with short exposure. In this invention Mr. Dallmeyer has produced a useful, and what may prove a valuable, instrument, and he has opened up quite a new horizon which will not suffer from lack of workers.

Hitherto the principle involved in the apparatus for the production of large images consisted first in obtaining the primary image, and second, in subjecting this image to the process of enlargement. To obtain the former a concave mirror, or more generally double convex lens, has been employed, while the subsequent magnification has been produced by placing a secondary magnifier or second positive lens behind the plane of the primary image.

This method, except in the case of astronomical work, has not been, we may say, popularly used, for the cumbrousness of the apparatus required, and the length of time necessary for exposure have quite prohibited its use for anything but inanimate subjects.

It is well known that the focal length of a lens is measured for practical purposes from the principal plane passing through one of the nodal points nearest the principal focal plane to that plane: in most lens-constructions this nodal point lies within the lens-mount. Now it will be seen that if this nodal point could be thrown in front of the lens, that is, on that side away from the focus, the focal length, if measured from the lens, would be shorter. This is exactly what Mr. Dallmeyer has done. In the simple telephotographic lens the anterior element, which is of large aperture and short focus, is a positive lens, while the posterior is negative, and of a fractional part of the focal length of the former lens. A diagram showing the lenses in position and the path of a ray of light remind one at first sight of the principle of the Galilean telescope, with this difference, that the rays emerging are not *divergent*, but *convergent*. In the construction under consideration the size of the image thrown on the screen can be varied at will by simply altering the distance between the elements, but the further the lens is from the focussing screen, the more will be the time of exposure.

With such a lens as this Mr. Dallmeyer has taken many excellent pictures, but perhaps the best idea of its properties will be gathered from the facts obtained by photographing—by means of two cameras, one supplied with a "long focus landscape lens," and the other with the "new telephotographic lens"—the flame of an oil lamp placed at a distance of 20 feet. With *equal* extensions of the camera the image of the flame given by the new lens was five times greater than that by the other.

In the *compound* lens the anterior element before referred to is here replaced by a complete portrait lens, while a negative symmetrical combination takes the place of the posterior element. This lens may be said to be more perfect than the *simple* lens, Mr. Dallmeyer having been able to introduce considerable improvement in the construction.

Some excellent work done with this lens has been exhibited by Messrs. F. Mackenzie and Annan at the Camera Club. The pictures represented a building at a distance of 500 yards. The first, taken with an ordinary rapid rectilinear lens with an extension of 14 inches, gave the house as ¾ of an inch long. The second—with the compound tele-photo lens, extension 9 inches from the back lens—gave 2½ inches as the size of the house, while the third, with 30 inches' extension, gave the house as 6⅛ inches. Although these numbers can give one a very good idea of what this new lens can accomplish, yet the direct copies from photographs inserted in the pamphlet under consideration convey a more vivid impression.

There is no doubt that this lens will find some very valuable applications, that of astronomical photography not being the least of them, for every one knows the great advantage a *short* telescope has over a long one if the degree of magnification in both are equal. W.

ARBORESCENT FROST PATTERNS.

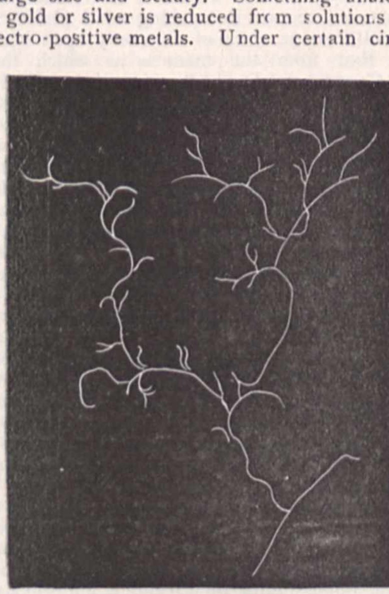
WE have received the following letters with regard to arborescent frost patterns, to which Prof. Meldola called attention in last week's NATURE:—

I AM very glad that Prof. Meldola has called attention to the curved figures of frozen mud (of which the specimens on December 4 were unusually fine), because I hope that some one will explain why the sexangular crystallization which is universal in snow, and general in water, is exchanged both on windows and on muddy pavements for curves. Probably I ought to know all about it, but I cannot remember seeing an explanation, and shall be obliged by reference to one, which will probably be of interest to others besides G. J. SYMONS.

62, Camden-square, London, N.W.

THE interesting "fronds" of muddy ice observed by Prof. Meldola (p. 126) are not very uncommon on the pavements in these "Northern Heights." I saw them on the date which he named, and have more than once studied them. I then noticed that the "interstitial" pavement seemed partly cleared of mud, as if the water had drawn this towards the groups of crystals. The mode of formation recalled to my mind certain phenomena in crystal building within rocks, and I suspect the mud has its influence. Indeed, it seems to me very probable that all these "dendritic" growths of crystals are the results of "impeded" or "constrained" crystallization, to some of which I have called attention in noticing a structure in the Charnwood syenite (*Quart. Jour. Geol. Soc.*, 1891, p. 101). On this point Prof. Sollas makes some important remarks in his well-known paper on the Wicklow granites. T. G. BONNEY.

THE beautiful curved forms assumed by the ice on the paving flags last Sunday were very noticeable in this neighbourhood and Hampstead as well as in other parts of London. What I observed were not quite like those described and figured by Prof. Meldola, but resembled rather the scrolls and volutes which are frequently used in decorative art. The finest piece that I saw was in this square, where several of these scrolls radiated from a central point, and spread over several feet of the pavement. A friend, Mr. E. Swain, observed that where one of these scrolls came upon a puddle of clear water the crystals were continued in a straight line. Such forms are not at all unusual in the freezing of muddy water, and at the present moment the puddles in the road opposite my house are filled with rectilinear crystals of ice, which assume a curved form in the mud at their margins. The peculiarity on Sunday was their large size and beauty. Something analogous takes place when gold or silver is reduced from solutions of its salts by more electro-positive metals. Under certain circumstances



the metal will present itself in the form of curved crystals, if the term be allowable. A pretty spray of gold of this character is figured in the report of my lecture "On the crystallization of silver, gold and other metals," in the proceedings of the Royal Institution, vi., 428. If a piece of cuprous oxide be immersed in a solution of nitrate of silver, there shoot from its surface thin threads of silver, which, after proceeding straight forward for a while, suddenly turn at an angle of 120° or 60°, and make perhaps many other deviations: but sometimes these threads, instead of being straight, are curved; and in that case the threads that branch from them are curved likewise. A magnified drawing of such a formation is given herewith. These strange departures from the usual rectilinear course of crystal formation are very curious, and deserve more study than has hitherto been given them. J. H. GLADSTONE.

17, Pembridge-square, December 10.

PROF. MELDOLA's letter (p. 125) has been interesting to me, as I noted a striking and similar phenomenon here on Thursday, December 8, in the forenoon. The trottoirs of several streets (east, west, north and south) were covered all over with beautiful patterns, somewhat different from Prof. Meldola's illustration, there being innumerable dark, broad, sharply-contoured leaf-like patches, distant several inches from each other, and connected by finely curved and branched tendril-like stalks. Foggy, with a faint north breeze. I should presume the "leaves" were due to sparse drops of sleet fallen during the night.

Freiburg, Badenia, December 10. D. WETTERHAN.

THE graceful arborescent frost patterns described by Prof. Meldola in last week's NATURE were very conspicuous on the foot-bridge by the side of Charing Cross railway bridge, on the same morning, this being a situation still more exposed to the wind which he mentions as the probable cause.

December 12. J. T. RICHARDS.

I OBSERVED the same phenomenon as Prof. Meldola describes in NATURE of December 8, on the same date, December 4, on pavements in Cheltenham, about 10.45 a.m.; after mid-day they had gone. I saw the patterns on pavements running north and south, as well as east and west. They were most exquisite; some like the illustration, others much more minute; but always in a connected design over the whole flag. They had all the appearance of fossil vegetation. I never saw anything of the kind before. J. J. ARMITAGE.

December 13.

MR. A. W. BENNETT and Mr. E. L. Garbett have also sent communications corroborating the phenomenon observed by Prof. Meldola. The former attributes it to "defoliation of the stones as the result of weathering or wear."

THE MAKING OF RIFLES.

AT a recent meeting of the Institution of Civil Engineers, Mr. John Rigby, superintendent, Enfield Factory, read an interesting paper on the manufacture of small arms. We reproduce from the abstract printed for the Institution Mr. Rigby's lucid account of the various processes of manufacture of the components of the Lee-Metford Mark I. magazine-rifle, of 0·303 inch bore, the weapon adopted for the British Army—an account which he prefaced with a general description of the Enfield Factory.

The most important part of a rifle was the barrel, which had always engaged the special attention of gun-makers. Up to the time of the Crimean War, it was, for the bulk of British troops, a comparatively rude tube of iron, lap-welded under rolls and tapering externally, with a cylindrical bore of about $\frac{3}{4}$ inch diameter. The barrel of the present day was a steel tube of accurate workmanship, only $\frac{3}{10}$ inch bore, almost perfectly true and straight, rifled to $\frac{1}{2000}$ inch, and so closely inspected that the existence of the most minute grey or seam in the bore, requiring a highly-practised eye to detect it, was sufficient to condemn it. The material used was produced either by the Siemens-Martin or the crucible process of manufacture, and was supplied to Enfield as a solid round bar $1\frac{3}{8}$ inch diameter and $15\frac{1}{2}$ inches long. After severe testing, this bar was passed through a rolling-mill to draw it to its full length: it was then taken to the forge, the swell at the breech-end was stamped to the required shape by a steam-hammer, and afterwards straightened cold. The next step was to submit the bar, without annealing, to the turning and drilling-machines. The latter were horizontal, the drills operating from each end. In the process of drilling, the barrel revolved at nearly 1,000 revolutions a minute against half-round bits held flat down, a capillary tube, of brass, supplying a soap-and-oil emulsion, at a pressure of 80 lb. to the square inch, to wash out the swarth and cool the cutting-edge. The drills advancing from each end continued boring until a small disk about $\frac{1}{100}$ inch diameter broke out, and the two holes met. The tendency of the drills to follow the line of axis of a revolving bar was one of those curious occurrences in practical mechanics which might be accounted for after observation, but which no one would predict. Occasionally, through some defect in the steel, a drill wandered from the axial line; in this case the barrel was taken from the machine and reset sufficiently to bring the hole true again. To test its truth, a ray of light was made to illuminate the flat bottom of the hole while the barrel slowly revolved. It was very rarely that a barrel was rendered waste from bad drilling. Rough-boring followed with a three-edged bit, the blade being about 4 inches long. The rough external turning was effected in self-acting lathes, which gave the required curved taper. Three or four cutters acted simultaneously, each producing a long cutting that attested the quality of the metal of the barrel. The operation of barrel-setting followed. Previous to rough-turning, the barrels were fairly straight internally, but the removal of the metal caused slight inequalities which were tested by the eye of the barrel-setter, and corrected by transverse blows. This constituted skilled labour of a peculiar character, and was performed by young men of good sight, who were specially trained for the purpose. After middle life the eye generally lost some of the quality necessary for this work, and it was rare to find a man excel in it after that period. Many mechanical devices had been contrived to supersede the simple ray of light laid, as if it were a straight edge, along the surface of the bore; but the eye still remained the arbiter of straightness and could be relied on for very accurate results. The construction of the barrel was completed by the important operation of rifling. In British small-arm factories the system was followed of planing out each groove separately with a hooked cutter, and had been brought almost to perfection. In Continental and American factories the grooves were ploughed out by cutters, with several cutting or knife-edges set at an angle and following one another in the manner of a single-cut file or float. Similar machines had been tried at Enfield, but did not give as smooth a cut as the slower-moving, single-tooth machines. A few passes of a lead lap, fed with fine emery, removed any burr that might remain, and completed the polish; a cylindrical lap, spinning rapidly, was then passed through, and gave the final finish to the barrels. The limits of gauging were from 0·303 to 0·305 inch.

Next in importance to the barrel was the mechanism of the breech, for which the material preferred was crucible cast-steel of a mild character, but capable of being hardened in those parts exposed to the pressure of the bolt. The body was forged in two operations under the steam-hammer; it was then drilled and subjected to a long series of operations, in the course of which the end was recessed to receive the screwed end of the barrel, and the corresponding thread in the recess was milled out in a specially-contrived machine, which insured that the thread should always start in the same place relative to the gauged part of the body, a point of great importance. The bolt, also of crucible cast-steel, was forged under the steam-hammer. A special machine, invented at Enfield, was used to finish the bolt after shaping. After machining, the bolts, packed in wood charcoal in iron cases, were heated and hardened by immersion in oil. The temper of the handle was then reduced in a lead bath. The rest of the bolt was tempered straw-colour. The bolt-head was similarly hardened and tempered.

The other components of a complete rifle were mostly shaped by mills built up to the proposed profile, or by copy-milling machines. The process of drifting was used with good results at Enfield. All such slots or perforations as had parallel sides, and were not cylindrical, were so finished. The common practice in drifting was to push the drift, but at Enfield much better work was accomplished by pulling. It was found that used in this way drifts were very valuable for interchangeable work. The sides were cut with successive teeth, each slightly larger than the preceding one, and the whole length of the drift was drawn through. Emery wheels were also largely used at Enfield as a substitute for finish-milling and filing. The wheels ran under hoods connected with a pneumatic exhaust that carried away the heated particles of steel and grit. It was popularly supposed that a machine once adjusted to turn out a component of a certain size and shape was capable of reproducing such in large numbers, all absolutely identical. This was so far from being the case that no die, no drill, and no milling-cutter actually made two consecutive articles the same size. The wear of the cutters or dies proceeded slowly but surely, and it was only possible to produce in large numbers components of dimensions varying between a superior and an inferior limit. In small-arm manufacture a variation of about one two-thousandth of an inch was about the amount tolerated, but it varied according to the size of the piece. A difference of diameter of one two-thousandth of an inch in the sight axis-hole, and in the size of the pin or axis, would cause a serious misfit, whereas a similar difference in the measurement of the magazine, or of the recess in which it lay, would be quite immaterial. The operations of gauging, proving the barrel, and sighting, were successively described, as also the manufacture of the stock, which was of the wood known as Italian walnut, though largely grown in other countries. Among the smaller components, the screws were mentioned as being rapidly produced by the automatic screw-making machines of Pratt and Whitney.

The Component Store received the various finished parts, which numbered 1591, or, including accessories, 1863, and issued them to the foreman of the assembling-shop. Theoretically, the assemblers should have nothing to do but to fit and screw them together, but in practice small adjustments were found necessary. The amount of correction was generally exceedingly small, and was done wherever possible with the aid of emery wheels. The completed arms were submitted to inspection, and then issued in cases of twenty each to the Weedon Government Store or elsewhere.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies propose that, in view of the increased attention given to palæontology in the Geological Department, a Demonstrator in Palæozoology be appointed, whose stipend shall be paid out of the students' fees.

The Botanic Garden Syndicate report the completion of the fine range of plant-houses, which have for some years been in course of erection at a cost of some £6000. It is noteworthy that the expense has been kept within the estimate.

The Senate has determined to raise the fee for the Doctor's degree (including M.D. and Sc.D.) from £20 to £25. It has rejected the proposal to increase the annual dues of undergraduates from 17*s.* to £2, and of graduates from 17*s.* to £1, which was put forth in view of the financial needs of the University, by the Fees Syndicate. The proposal to accept life-compositions for the annual dues was also rejected. Dr. Allbutt Regius Professor of Physic, has been appointed an Elector to the Chair of Botany, in the place of the late Dr. Hort.

The discussion on the plans for the new Geological Museum (given at length in the *University Reporter* for December 13) was highly interesting, and appears on the whole to have been favourable to the scheme proposed, subject to relatively unimportant modifications. Prof. Newton objected that the arrangement of its contents should be zoological rather than stratigraphical; and the Registrary (Mr. J. W. Clark) took exception to the plan of lighting, which would be better if it were from the top rather than the sides. The geological staff were unanimous that the plan put forward was that which best met their needs. It was agreed that the architectural effect of the museum would be very fine, and worthy of Sedgwick's memory.

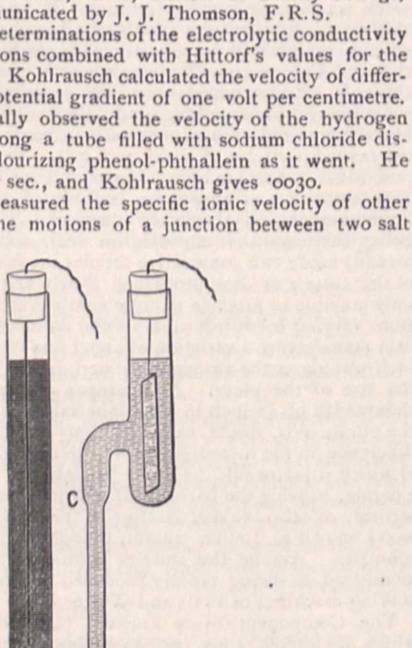
SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—"Ionic Velocities." By W. C. Dampier Whetham, B.A., Fellow of Trinity College, Cambridge. Communicated by J. J. Thomson, F.R.S.

From a series of determinations of the electrolytic conductivity of various salt solutions combined with Hittorf's values for the migration constants, Kohlrausch calculated the velocity of different ions under a potential gradient of one volt per centimetre. Dr. O. Lodge actually observed the velocity of the hydrogen ion as it travelled along a tube filled with sodium chloride dissolved in jelly, decolourizing phenol-phthallein as it went. He found ·0029 cm. per sec., and Kohlrausch gives ·0030.

The author has measured the specific ionic velocity of other ions by observing the motions of a junction between two salt



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solutions of slightly different density and different colours, when a current was passed across it. From the velocity of the boundary, that of the ion causing the change in colour can be deduced, The apparatus consisted of two vertical glass tubes about 2 cms. in diameter, joined by a third considerably narrower, which was bent parallel to the others for the greater part of its length. The tube was filled with the solutions in such a manner that the boundary was formed in the vertical part of the junction tube.

When the solutions are of different specific resistances there will be a discontinuity of potential gradient at the boundary and a consequent electrification. The effect on the velocity of the boundary is, however, non-reversible, and, for small differences, can be eliminated by taking the mean of the velocities in opposite directions. The direct estimation of potential gradient is unsatisfactory, but by measuring the current (γ), the area of cross-section of the junction tube (A), the specific resistance of the solution (r), and the velocity of the boundary (v) we can find the specific ionic velocity v, for $v, = \frac{v\text{A}}{\gamma r}$.

The first solutions used were those of copper and ammonium chlorides dissolved in aqueous ammonia, the former being blue, the latter colourless. The junction travelled with the current with a velocity of 1·57 cm. per hour going upwards and of 1·60 cm. per hour coming downwards. The mean gives as the specific ionic vel. of Cu in solutions of ·1 gram. equiv. per litre ·000309 cm. per sec. This agrees exactly with Kohlrausch's number for infinitely weak solutions of ·00031 cm. per sec. Other measurements were made for chlorine and for the bichromate group (Cr_2O_7).

The method was extended to alcohol solutions. The velocities of both ions of a salt were determined by using two pairs of solutions. Thus the velocity of chlorine was found by using a cobalt chloride-cobalt nitrate pair, the colours of which are blue and red respectively, and that of cobalt by a cobalt chloride-calcium chloride pair, these being blue and colourless. The sum of these velocities was compared with that deduced by Kohlrausch's method from the conductivity of the solution. The following are the results :—

SPECIFIC IONIC VELOCITIES.

I.—*Aqueous Solutions.*

Ion	Velocity observed	Velocity calculated
Copper	0·00026* 0·000309	0·00031
Chlorine	0·00057* 0·00059*	0·00053
Bichromate group (Cr_2O_7)	0·00048 0·00047 0·00046	0·000473

* Preliminary observations.

II.—*Alcoholic Solutions.*

Salt	Vel. of Anion observed	Vel. of Kation observed	Sum of vels. observed	Sum of vels. calculated
Cobalt Chloride ...	0·000026	0·000022	0·000048	0·000060
Cobalt Nitrate ...	0·000035	0·000044	0·000079	0·000079

December 8.—"On the Velocity of Crookes' Cathode Stream." By Lord Kelvin, P.R.S.

In connection with his splendid discovery of the cathode stream (stream from the cathode in exhausted glass vessels subjected to electric force), Crookes found that when the whole of the stream, or a large part of the whole, is so directed as to fall on 2 or 3 sq. cm. of the containing vessel, this part of the glass becomes rapidly heated up to many degrees, as much as 200° or 300° sometimes, above the temperature of the surroundings.

Let v be the velocity, in centimetres per second, of the cathode stream, and ρ the quantity of matter of all the molecules in 1 c.c. of it. Supposing what Crookes' experiments seem to prove to be not far from the truth, that their impact on the glass is like that of inelastic bodies, and that it spends all their translational energy in heating the glass. The energy thus spent, per square centimetre of surface struck, per second of time, is $\frac{1}{2}\rho v^3$; of which the equivalent in gramme-water-centigrade thermal units is approximately $\frac{1}{2}\rho v^3/42{,}000{,}000$. The initial rate at which this will warm the glass, in degrees centigrade per second, is

$$\frac{\frac{1}{2}\rho v^3}{10^6 \times 42 \, . \, \sigma a} \quad \ldots\ldots\ldots\ldots (1),$$

where σ denotes the specific heat of the glass, and a the thickness of it at the place where the stream strikes it.

The limiting temperature to which this will raise the glass is

$$\frac{1}{\text{E}} \times \frac{\frac{1}{2}\rho v^3}{42{,}000{,}000} \quad \ldots\ldots\ldots\ldots (2)$$

where E denotes the sum of the emissivities of the two surfaces of the glass in the actual circumstances.

It is probable that ρ differs considerably from the average density of the residual air in the enclosure. Let us take, however, for a conceivably possible example, $\rho = 10^{-8}$, which is what the mean density of the enclosed air would be if the vessel were exhausted to 8×10^{-8} of the ordinary atmospheric density.

To complete the example, take

$$v = 100{,}000 \text{ cm. per sec.}$$

(being about twice the average velocity of the molecules of ordinary air at ordinary temperature); and take

$$\sigma a = \tfrac{1}{8} \text{ cm.},$$

as it might be for an ordinary glass vacuum bulb; and take

$$E = \tfrac{1}{3000},$$

which may not be very far from the truth.

With these assumptions, we find, by (1) and (2) approximately, 1° per second for the initial rise, and 375° for the final temperature, which are not very unlike the results found in some of Crookes' experiments.

The pressure of the cathode stream of the velocity and density which we have assumed by way of example is ρv^2, or 100 dynes per square centimetre, or about 100 milligrams heaviness per square centimetre, which is ample for Crookes' wonderful mechanical results.

The very moderate velocity of 1 kilom. per second which we have assumed is much too small to show itself by the optical colour test. The fact that this test has been applied, and that no indication of velocity of the luminous molecules has been found, has, therefore, no validity as an objection against Crookes' doctrine of the cathode stream.

Chemical Society, November 17.—Sir Henry Roscoe, Vice-President, in the Chair.—The Chairman congratulated the Fellows on the great improvement effected in the Society's rooms by the alterations carried out during the recess An address has been forwarded to the sister society in Berlin on the occasion of the celebration of its twenty-fifth anniversary. A resolution was passed at a meeting of the Council expressing deep regret that, through the death of Dr. Longstaff on September 23 last, the Society has lost its senior Fellow and one of its Founders. The following papers were read:—Fluosulphonic acid, by T. E. Thorpe and W. Kirman. This paper has been already reported in this volume, page 87.—Note on the interaction of iodine and potassium chlorate, by T. E. Thorpe and G. H. Perry. The reaction which occurs when iodine and potassium chlorate are heated together is usually represented by the equation $3KClO_3 + I_2 = KClO_4 + KCl + KIO_3 + ICl + O_2$; the authors find, however, that the main reaction consists in a simple interchange of iodine and chlorine thus—$2KClO_3 + I_2 = 2KIO_3 + Cl_2$.—The magnetic rotation of sulphuric and nitric acids, and of their aqueous solutions; also of solutions of sodium sulphate and lithium nitrate, by W. H. Perkin, sen. The author has previously shown that the molecular rotation of sulphuric acid is considerably influenced by the presence of water; the rotation rapidly falls for small dilutions, but diminishes as the amount of water is increased. The results are now extended; in the cases of sulphuric acid and sodium sulphate there is no apparent connection between the values representing the rotation and the extent to which dissociation is supposed to occur down to solutions containing 9 per cent. of acid or 12 per cent. of sodium sulphate. At a temperature of 90° the rotation is increased instead of diminished as indicated by the dissociation hypothesis. The results are not inconsistent with the assumption that the hydrate $(HO)_4SO$ is formed. In the case of nitric acid, the curve connecting rotation and percentage of acid is a straight line down to solutions containing 33 per cent. of HNO_3, and then apparently bends down somewhat; the results are not in agreement with the exigencies of the dissociation hypothesis. A compound of the composition $(HO)_3NO$ may be produced. Lithium nitrate resembles nitric acid in its behaviour. The rotations of strong aqueous solutions of the haloid hydrides change very rapidly with small dilutions, but more slowly with larger dilutions, becoming finally nearly stationary; such behaviour is not in accord with the dissociation hypothesis.—Note on the refractive indices and magnetic rotations of sulphuric acid solutions, by S. U. Pickering. Van der Willingen's results for the refractive indices of sulphuric acid solutions yield curves showing a well-marked "break" at 84·5 per cent. (H_2SO_4; H_2O), another "break" at 57·7 per cent. (H_2SO_4; $4H_2O$), and another at 24–30 per cent. The first two of these are also found on the magnetic rotation curves and all three of them agree with breaks found in the examination of other properties. The molecular volumes of solutions of the same strength as those used by Perkin when plotted out exhibit the same three breaks on the curve.—The hydrate theory of solutions. Some compounds of the alkylamines with water, by S. U. Pickering. The following table gives the compositions of a number of crystalline hydrates of fatty amines which the author has succeeded in isolating and analyzing:—

$EtNH_2,5H_2O$	$EtNH_2,5{\cdot}5H_2O$
$PrNH_2,5H_2O$	$Bu^{\beta}NH_2,7H_2O$
$Et_2NH,5H_2O$	$Me_2NH,7H_2O$
$Pr_2NH,5H_2O$	$Pr^{\beta}NH_2,8H_2O$
Me_2NH,H_2O	$PrNH_2,8H_2O$
$Et_3N,2H_2O$	$Et_2NH,8H_2O$
$Me_3N,3H_2O$	$Me_3N,11H_2O$

The freezing points of the hydrates ranged from + 5° to − 71°; indications of the existence of other hydrates were also obtained by "breaks" in the curves representing the freezing points of the solutions, and in every instance but one a hydrate of the composition thus indicated in the case of one amine was actually isolated in the crystalline condition in the case of some other amine. In connection with this subject Prof. Thorpe showed a very pretty experiment to illustrate the fact that whilst a mixture of triethylamine (15–50 per cent.) is clear and transparent at ordinary temperatures, the solution becomes turbid on warming, owing to the amine being thrown out of solution; on applying pressure to the warm liquid, however, re-solution occurs.—The atomic weight of boron, by E. Aston and W. Ramsay. The authors have investigated the atomic weight of boron; the atomic weight found from determinations of the water of crystallization of borax is 10·921 ± 0·01. The conversion of anhydrous sodium borate into sodium chloride by distilling it with hydrochloric acid and methyl alcohol and weighing the sodium chloride obtained gives an atomic weight of 10·966 for boron. The authors consider that Abrahall's number (10·825) for this constant is too low, as the boron bromide employed by him might have been contaminated with the compound BBr_3,HBr.—Methoxyamido-1 : 3-dimethylbenzene and some of its derivatives, by W. R. Hodgkinson and L. Limpach. An almost theoretical yield of 1 : 2 : 4-metaxylenol may be obtained by steam distilling a diazotized 5 per cent. solution of the corresponding xylidine sulphate. The product solidifies in a mixture of solid carbonic anhydride and ether. On nitration a theoretical yield of a mononitro-derivative ($NO_2 : OH = 1 : 2$) is obtained. A number of other compounds are described.—An extra meeting of the Society will be held on Tuesday, December 13, at 8 p.m., the anniversary of the death of Stas. A paper by Prof. J. W. Mallet, entitled "Jean Servais Stas, and the measurement of the relative masses of the atoms of the chemical elements" will be read and discussed.

Physical Society, Nov. 25.—Prof. S. P. Thompson, F.R.S., Vice-President, in the chair.—The followingcommunication was made: Experiments in electric and magnetic fields, constant and varying, by Messrs. Rimington and Wythe Smith. In the first set of experiments shown exhausted electrodeless tubes and bulbs were rotated rapidly in a constant electric field between two parallel charged discs. Double fan-shaped images were produced by the tubes, due to the displacement currents which pass to equalize the potentials at the ends of the tubes. These fans were not symmetrical with respect to the lines of electric force, but were displaced in the direction of rotation. In explanation of this phenomenon it was pointed out that as a tube rotated the potential difference between its ends increased until this difference was sufficient to break down the dielectric in the tube. The discharges would therefore pass at the ends of the intervals during which the difference of potential was rising, and consequently the images would be displaced from the symmetrical position in the direction of rotation. The number of discharges produced during one revolution was found to depend on the strength of the electric field, but not on the speed of rotation, and that end of the tube which was approaching the negatively charged plate appeared brightest. These experiments were referred to as examples of the direct conversion of mechanical energy into light. Instead of rotating tubes in a constant electric field, the tubes were next kept stationary, and a varying electric field produced by connecting the plates with an influence machine allowed to spark; under these conditions the tubes and bulbs were seen to glow. Using large suspended plates charged by an induction coil, long tubes were caused to glow brightly even at considerable distances away from the plates. The glow could be apparently wiped out by passing the hand along the tube. Another series of experiments were performed in varying magnetic fields. With a view to showing Hertzian phenomena to large audiences the authors tried Geissler tubes to replace the spark-gap in resonators, with great success. When large Leyden jar circuits were used the effects were very brilliant. Another form of resonator consisted of a bent wire terminating in two plates, between which an exhausted tube was placed. This tube became luminous when the resonator was placed in the vicinity of a fairly large Hertz oscillator. Other experiments similar to those shown before the society at Cambridge by Prof. J. Thomson, on discharges in exhausted bulbs were then made, the bulbs being placed with a coil of wire of four turns, forming the connection between the outer coatings of two small jars, whilst sparks passed between knobs connected with the inner coatings. The bulbs glowed brightly at each discharge, rings of light being seen near their inner surfaces. On putting a ring tube outside the coil this was also seen to glow. The most brilliant part of the glow always occurred in close proximity to the wire coil. A secondary coil, wound by the side of the above-mentioned primary, could be short-circuited at will; this had the effect of decreasing or extinguishing the luminosity in the bulb or tube. Bright sparks passed between the secondary terminals when held a short distance apart, but the shock experienced by touching the ends was not serious. The above arrangement, with the addition of two Geissler tubes placed in series between the outer coatings of the jars, was used to illustrate the fact that closing the secondary diminishes the impedance of the primary circuit of a transformer. Experiments on condensers made of tin-foil on glass were shown. In one of them, parts of the coatings in the form of letters had been removed, and the spaces became luminous when the condenser was connected with an induction coil. In another experiment a glass plate was moved to and from a condenser, and a musical note could be heard whose pitch increased as the distance between the glass plates diminished. The note was said to be the octave of an open organ pipe, whose length was equal to the distance between the plates. Mr. Swinburne thought some of the effects shown were not Hertzian, but merely cases of ordinary mutual induction. He inquired whether the vacuum tubes would still glow if the Leyden jars were removed from the so-called resonating circuits. He was also of opinion that in the magnetic experiments the surfaces of the bulbs, and not the enclosed gases, took the charges. Mr. Watson asked if the authors had tried screening off the long waves by a wet cloth. If the effects still existed, this would prove that they were Hertzian. Mr. Blakesley wished to know if the images of the rotating tubes were at equal angular distances. Mr. Smith pointed out that these distances were not equal, but corresponded to equal changes of potential. Prof. Ayrton remarked that the only cases where the materials of the bulbs, tubes, &c., did not influence the results were those in which discharges were produced by varying magnetic fields. Mr. E. T. Carter thought an induction coil a more efficient machine for producing the glow in tubes than the alternator, &c., used by Mr. Tesla. Mr. Trotter asked if the authors had observed whether the glow produced by passing a discharge through a wire wound in a long pitch spiral round a tube formed an open or a closed circuit of light. Prof. S. P. Thompson said he first noticed that sparks passed between pieces of metal in the vicinity of an induction coil sparking into a condenser in 1876, when he was showing some experiments on telegraphic apparatus before the society, but unfortunately he did not pursue the subject. Long before Mr. Tesla's investigations Dr. Bottomley had shown that exhausted tubes could be caused to glow, but it was not until Tesla produced such phenomena on a large scale that people recognized how much light could be got in that way. Mr. Rimington, in replying to a question by Prof. Thompson, said the notes heard when the glass plate approached the condenser were of very high pitch. The explanation why in the experiments performed in varying magnetic fields, the bright parts of the luminous discharges were near the wire, appeared to be that the E.M.F. was greatest in these places. Although he had not tried the experiment, suggested by Mr. Swinburne, of taking off the Leyden jar, he felt sure that doing so would stop the glow.

Geological Society, November 23.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read:—Outline of the geological features of Arabia Petræa and Palestine, by Prof. Edward Hull, F.R.S. The region may be considered as physically divisible into five sections, viz. (1) The mountainous part of the Sinaitic Peninsula; (2) the table-land of Badiet-el-Tîh and Central Palestine; (3) the Jordan-Arabah valley; (4) the table-land of Edom, Moab, and the volcanic district of Jaulân and Haurân; and (5) the maritime plain bordering the Mediterranean. The most ancient rocks (of Archæan age) are found in the southern portion of the region; they consist of gneissose and schistose masses penetrated by numerous intrusive igneous rocks. They are succeeded by the lower carboniferous beds of the Sinaitic peninsula and Moabite table-land, consisting of bluish limestone with fossils, which have their counterparts chiefly in the carboniferous limestone of Belgium, and of a purple and reddish sandstone (called by the author "the desert sandstone," to distinguish it from the Nubian sandstone of Cretaceous age), lying below the limestone. The Nubian sandstone, separated from the carboniferous by an enormous hiatus in the succession of the formations, is probably of Neocomian or Cenomanian age, and is succeeded by white and grey marls, and limestones with flint, with fossils of Turonian and Senonian ages. The Middle Eocene (Nummulitic limestone) beds appear to follow on those of Cretaceous age without a discordance; but there is a real hiatus, notwithstanding the apparent conformity, as shown by the complete change of fauna. In Philistia a calcareous sandstone in which no fossils have been observed is referred to the Upper Eocene; for the Miocene period was a continental one, when faulting and flexuring was taking place, and the main physical features were developed—*e.g.* the formation of the Jordan-Arabah depression is referable to this period. In Pliocene times a general depression of land took place to about 200–300 feet below the present sea-level, and littoral deposits were formed on the coasts and in the valleys. To this period belong the higher terraces of the Jordan-Arabah valley. The Pliocene deposits consist of shelly gravels. Later terraces were formed at the epoch of the glaciation of the Lebanon mountains, when the rainfall was excessive in Palestine and Arabia. The volcanoes of the Jaulân, Haurân, and Arabian desert are considered to have been in active operation during the Miocene, Pliocene, and Pluvial periods; but the date of their final extinction has not been satisfactorily determined. After the reading of this paper the president remarked on the interest of the geology of an area, which was that of the Bible. Many authors had recorded their observations on this district, one of the latest being the author of this paper. Some years ago Mr. Holland had read a paper before the Society, and he (the speaker) believed that that writer was actually the first to prove the existence of carboniferous fossils in the Sinaitic peninsula. He remarked that *Lepidodendron mosaicum*, described by Salter, was somewhere preserved in the Society's museum, so that the Society had long ago had evidence of carboniferous rocks. Mr. Bauerman's paper, which was a reconnaissance in a comparatively unknown district, created great interest; and when that paper was read doubt was expressed as to whether the fossils then exhibited were carboniferous or triassic. After the researches of Prof. Hull there was no doubt that carboniferous rocks do occur in the region. As regards the granitic rocks (extending far up the Nile valley, in the Sinaitic peninsula, and elsewhere), they were all of much the same character, and, according to Sir William Dawson, occurred at two horizons—the lower rocks being granitoid and gneissic, the upper more or less volcanic, but still pre-carboniferous. He asked the author whether the Poudingues de Jebel Haroûn of Lartet were or were not ancient volcanic rocks. The Nubian sandstone of older writers included many things, but the age of the various sandstones was now satisfactorily determined by the author. Some were carboniferous, others (in the speaker's opinion) cenomanian. The calcareous formations of Judæa were well known from the writings of Lartet, Fraas, and others; but the exact line of demarcation between the Nummulitic limestone and the true Cretaceous had never been determined. It was a curious fact, as stated by Von Zittel, that not one fossil was common to the two deposits, which were nevertheless quite conformable. Miocene beds appeared to be absent, for, as noted by Lartet and confirmed by the author, this was a period of movement, when the great valley and the great fault were initiated. He (the speaker) felt that there were many difficulties connected with the depression which had not yet been cleared up. Lartet, Hitchcock, and others had traced the general direction of the fault; but the author had determined its exact site at more than one point. The most interesting point in this connection was the question of the age of the 700-foot saddle separating the Akabah watershed from the Jordan-Arabah depression. This saddle, in fact, separates the Jordan-Arabah depression from the Red Sea basin. Was it probable that this saddle was contemporaneous with the longitudinal fracture? Much depended on the determination of this question. Canon Tristram had shown that the fishes of the Jordan waters presented some curious analogies with the fish fauna of those of Africa, and Günther, after studying his specimens, had confirmed this view. He (the speaker) believed that this connection was not over the saddle of the Arabah, but might have been the 285-foot pass of the gorge of Jezreel. If the Pliocene depression, which the author thought was at least 200 feet, was a little greater, it would at least cause an outflow in this direction. As to the date of the basaltic eruptions, he thought the author's explanation was not unreasonable. He remarked that the Jordan-Arabah valley must have been of considerable antiquity, and had many lateral valleys of erosion more or less pointing towards the central hollow of the Dead Sea, whether from the Jordan or the Arabah end. Whither had the material thus eroded gone? It could not have passed over the saddle into the Red Sea, for the drainage had evidently been towards the Dead Sea for ages. He allowed that much was soluble limestone; but that must be precipitated somewhere, and the only conclusion he could come to was the somewhat heretical belief that the bottom of the Dead Sea had been an unsound one. Messrs. Irving, J. B. Lee, Topley, Hinde, and Whitaker also spoke. The author accounted for the change of species between the Cretaceous and Eocene limestones, as determined by Zittel, by supposing that at the close of the Cretaceous period the sea-bed had been elevated into a land-surface—but without flexuring—owing to which the life-forms of the Cretaceous ocean were destroyed, and upon resubmergence new forms entered from the outer ocean; in this way there would be no appreciable discordance of stratification, but complete change of species. As regards the origin of the saddle in the Arabah valley, he believed it was formed during the formation of the valley itself, not subsequently; the valley contracted very much at the saddle.—In reply to Mr. Topley's question, the author stated he had been informed that there was a very distinct terrace of gravel near the lake of Huleh, corresponding in level with that in the Arabah valley. About 1200 feet above the Dead Sea surface the intermediate representatives of this terrace may be found, but doubtless had been to a large extent swept away by floods and rains. In attempting to account for the difference between the faunas of the Red Sea and Mediterranean, it would be clear that once the isthmus of Suez had been converted into land, and the seas dissevered, differentiation would begin and proceed till all the forms unsuited to each had disappeared; difference in the temperature of the waters of the two seas would be the chief cause of differentiation.—The base of the Keuper formation in Devon, by the Rev. A. Irving.—The marls and clays of the Maltese Islands, by John H. Cooke.

OXFORD.

University Junior Scientific Club, November 23.—The above club held its 124th meeting in the Physiological Laboratory, Dr. J. Lorrain Smith, President, in the chair.—Mr. E. M. Hamilton, Keble, brought before the club what proved to be a most interesting subject in his exhibit of "Flexible Sandstone," he pointed out that but little was known of the structure and consistence of this curious rock; it was found in India and was known by the name of Itacolumite. Mr. Hornby, Queen's, mentioned that he had investigated part of the specimen exhibited under the microscope after previous crushing; he held that the flexibility was due, not to mica, as was by some proposed, for in some specimens there was no mica, but rather to rough ball-and-socket joints between the grains; this idea was suggested by the irregular indentations observed in some granules and projections in others.—Prof. Green agreed with Mr. Hornby's theory as extremely probable; he gave an able *résumé* of the subject, and expressed his idea that there are more than one kind of rock roughly known as Itacolumite. He pointed out how the ball-and-socket arrangement might be produced, by the influence of pressure, in the presence of some dissolving agent, of which the power would be increased at any point of pressure, and so allow one granule to bore into another.—Mr. Sworn then gave a somewhat lengthy description of some results he had obtained with his rotatory hypsometer in actual use. When after the lapse of time, this subject was exhausted by Mr. Sworn, the club heard Mr. McDonald, Keble, who read a very able paper on the stereochemistry of nitrogen; the paper contained a review of all the latest work on this subject, and was amplified by models illustrative of the constitution of the various isomeric bodies mentioned.—During the meeting it was announced that Lord Kelvin had consented to deliver the "Robert Boyle" lecture in connection with this club, next summer term, the subject being "Magnetic Waves."

December 2.—Dr. J. Lorrain Smith, President, in the chair.—In the absence of Mr. Gunther, Magdalen, Mr. Hill, New College, gave his exhibit of a caterpillar which was found in Java. It was interesting on account of the curious flattened hairs with which it was provided, and has not yet been classified. After a short discussion the President read a paper on the thyroid gland, in which he described a series of experiments performed by him on cats as being the most suitable animal. He found that although the cats almost invariably died after removal of the thyroid gland, yet some lived a considerable time, and even improved in health and appearance. One cat in particular was even now in good health, although it was operated on in June of the present year. However, in this case a decrease of temperature brought on distressing symptoms such as convulsions. He further showed that though the respiration temperature and amount of the products of metabolism varied, the "quotient" remained constant. The animals thus, after removal of the gland, dying "quantitatively and not qualitatively." After a discussion, in which Dr. Turrell, Messrs. Pembery, Ramsden, Butler, and others took part, Mr. V. H. Veley read a paper on the necessity of water in chemical reactions. The author reviewed the works of Baker and others, illustrating his remarks by experiments. Then passing to his own research he showed that concentrated nitric acid did not react with dry sodium nitrite, and further that dry carbon dioxide and sulphurous oxide were not absorbed by dry calcium oxide. If absorption did take place, the amount was directly proportional to the quantity of water present.

DUBLIN.

Royal Dublin Society, November 16.—Prof. W. Noel Hartley, F.R.S., in the chair.—Prof. T. Johnson described an Irish alga—*Pogotrichum hibernicum*—new to science. He found it growing on *Alaria esculenta*, Grev., at Kilkee, co. Clare, in September, 1891. *P. hibernicum* differs from *P. filiforme*, Rke, in having unilocular and plurilocular sporangia in the same tuft, in having endophytic proliferous hyphæ, and in size. Comparison between *P. hibernicum* and *Litosiphon laminariæ*, Harv., of which herbarium material had been examined, was made. The paper was well illustrated by means of the Society's electric projector.—Mr. Alfred Harker then read a paper (communicated by Prof. W. J. Sollas, F.R.S.), on the use of the protractor in field-geology. Representing the inclination of a plane to a fixed plane as a vector of the type given by the gnomonic projection, the author deduces the laws of composition and resolution of such vectors, &c. Since the quantities can be laid down at once by a straight protractor, the common problems of field-geology and mining admit of ready graphical solutions.—Mr. John R. Wigham described a means of preventing the pollution of water of cities and other places where ball hydrants are used. He described the action of ball hydrants which, while making a perfectly tight and true joint while the pressure of water was in the mains, immediately fell from their seats when that pressure was removed for repairs, attachment of service pipes, &c., or reduced for any reason, and thus immediately admitted into the mains any liquid, whether pure or impure, which might be lying on the surface of the street or roads near the hydrant, and pointed out a simple remedy devised by Mr. Kelly, water inspector of Blackrock township. It consists of a spiral spring inserted beneath the ball of the hydrant, which assists the water to keep the ball in its place, and is at the same time strong enough to hold the ball firmly there when the pressure of water is removed. By the adoption of this spring, which is easily applied and inexpensive, costing only a few shillings, all danger of pollution from surface water is absolutely averted.—Mr. G. H. Carpenter submitted a supplementary report on the Pycnogonida collected by Prof. Haddon in Torres Straits, enumerating two additional species—*Pallenopsis Hoekii* (Miers), and *Rhopalorhynchus claripes*, sp. nov.—Sir Charles A. Cameron, M.D., communicated a paper on the action of phosphine on selenium di-oxide.

PARIS.

Academy of Sciences, December 5.—M. d'Abbadie in the chair.—On an opinion brought forward at the British Association concerning sun-spots, by M. H. Faye. Regarding the suggestion that an electric discharge, in accelerating evaporation, might produce a lowering of temperature sufficient to cause the local decrease of brilliance known as a sun-spot, M. Faye points out the improbability of an electric discharge in a mobile medium lasting for a whole month, with the vapours constantly condensing on every portion of the sun's surface.—Chemical study of opium smoke, by M. Henri Moissan. Samples of the preparation of opium for smoking purposes, known as chandoo, were subjected to fractional distillation between the temperatures of 250° and 400°. At the former temperature a bluish smoke was given off, carrying with it certain agreeable perfumes and a small quantity of morphine. This ceased after a while, and the temperature had to be raised to 300°, when a more whitish smoke was liberated, which was less odorous and more acrid, and contained a small quantity of morphine, together with more or less poisonous bases. The latter reaction was also the only one obtained from the combustion of "dross" and adulterated opium, which give off poisonous compounds, such as pyrrol, acetone and hydropyridic bases.—Observations on the preceding communication, by M. Arm. Gautier.—On stereochemical notation, by M. C. Friedel (reply to the second note by M. Colson).—Calculation of continuous beams; a method in accordance with the new regulations of the ministerial order of August 29, 1891, by M. Bertrand de Fontviolant. This is a method of graphic statics applicable to all cases of moving loads, based upon the construction of the "lines of influences" of the bending moments, shearing stresses, reactions of supports, and elastic yieldings respectively. The problem is the following: Given two points in a plane, A and B, and a system of parallel continuous forces whose intensities are linear functions of the abscissæ of their points of application, to trace a funicular curve of these forces with polar distance equal to $\frac{1}{6}$ the projection of A B on a direction perpendicular to these forces.—Observations of Wolf's periodic comet, made with the great telescope of the Toulouse Observatory, by MM. E. Cosserat and F. Rossard.—Observations of Holmes's new comet, made at the Algiers Observatory, by MM. Rambaud and Sy.—Observations of Brooks's comet (discovered November 21, 1892), made at the Marseille Observatory, by M. Esmiol.—Observations of the same, made by M. Fabry (see Astronomical Column).—On infinite groups of transformations, by M. A. Tresse.—On an indeterminate problem of analysis connected with the study of hyperfuchsian functions resulting from hypergeometrical series with two variables, by M. Levavasseur.—On the fusion of carbonate of lime, by M. H. Le Chatelier.—Remark on a note by M. Barthe concerning the volumetric estimation of the alkaloids, by M. P. C. Plugge.—Physiological researches on opium smoke, by MM. N. Gréhant and Ern. Martin. Experiments performed upon a dog under conditions analogous to those observed by opium-smokers failed to produce any perceptible effect. One of the experimenters then smoked twenty pipes himself, the quantity of opium amounting to four grains. The experiment lasted for an hour. After the fourth pipe a frontal headache supervened, which became general after the sixth. At the tenth he felt giddiness, especially in walking; but these effects were not aggravated up to the close of the experiment, and had disappeared an hour afterwards. The respiration showed a lesser amplitude towards the end, the beating of the heart was slightly less frequent, and the curves of pulsation were more flattened at the summits.—On the measure of the permeability of soils and the determination of the number and the surface of the particles contained in 1 cc. of soil, by MM. F. Houdaille and L. Semichon.—On the exchanges of carbonic acid and oxygen between plants and the atmosphere, by M. Th. Schlœsing, jun.—The artificial production of rutile, by M. L. Michel. The following is a new process: Heat during several hours in a graphite crucible, at a temperature of about 1200°, an intimate mixture of 1 part titaniferous iron and 2½ parts pyrites. On cooling, a crystalline mass is found, which breaks easily, and exhibits all the physical and chemical characteristics of pyrrhotine. This mass is riddled with small holes, to the walls of which are attached crystals, which possess the composition and the crystallographic and optical properties of rutile. They can be easily separated by means of hydrochloric acid.—On a new ellipsometer, by M. Jannettaz.—On the existence of inversion phenomena in the neighbourhood of Gréoulx (Basses-Alpes), and on the age of these dislocations, by M. W. Kilian.

BERLIN.

Physical Society, November 4.—Prof. du Bois Reymond, President, in the chair.—Dr. du Bois described and explained the phenomena he had observed during the passage of polarized light through gratings, and dealt with the polarizing effects of the latter. He also discussed the relation of the phenomena to those described by Guy, as accompanying the deflection of light at metallic edges, and to those observed by Hertz during the polarization of long electric waves by wire gratings. Dr. Gross made a further statement on entropy, criticizing Clausius's proofs and advancing a general theorem from which the principle of entropy can be deduced. His views were opposed by Prof. Planck. Prof. Erdmann exhibited excrescences 3 c.m. in length attached to an aluminum penholder which had lain in contact with mercury; they consisted of hydrate of alumina.

Note.—In the report of the meeting of October 21 (NATURE, vol. xlvii. p. 24), column one, last line, for "lime-spectrum" read "line-spectrum," and in last line of column two, for "amalgams" read "alloys."

Meteorological Society, November 8.—Prof. von Bezold, President, in the chair.—Dr. Lachmann spoke on temperature. extremes in the United States (North America), based on the recently published results of observations extending over twenty years.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—Child-Life Almanac, 1893 (Philip).—An Elementary Text-Book of Physiology: J. M'Gregor-Robertson, 2nd edition (Blackie).—Reformed Logic: D. B. McLachlan (Sonnenschein).—The Naturalist on the River Amazons: H. W. Bates; with a Memoir of the Author, by E. Clodd (Murray).—Elements of Agriculture: Dr. W. Fream, 4th edition (Murray).—Our Earth—Night to Twilight: G. Ferguson (Unwin).—Report on the Meteorology of India in 1890: J. Eliot (Calcutta)—Carl Wilhelm Scheele, Nachgelassene Briefe und Aufzeichnungen: A. E. Nordensköld (Stockholm, Norstedt).

PAMPHLET.—Columbus and his Discovery of America: H. B. Adams and H. Wood (Baltimore).

SERIALS.—Journal of the Marine Biological Association, new series, vol. ii., No. 4 (Dulau).—Engineering Magazine, December (New York).—Himmel und Erde, December (Berlin, Paetel).—Journal of the Straits Branch of the Royal Asiatic Society, December 1891 (Singapore).—Actes de la Société scientifique du Chili, tome ii, 1ère livraison (Santiago).

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