THURSDAY, MAY 31, 1877

THE UNIVERSITIES BILL AND UNIVERSITY MOVEMENTS

THE monotonous progress of the Oxford and Cambridge Bill through the House of Commons has never been interrupted. The Government having drawn its measure, consents to modify it in a few trivial points, but wherever it does not consent, the House accepts it and passes it as an elementary matter of party discipline. Very few of the amendments are of serious importance. Lord Edmond Fitzmaurice has added perhaps the most valuable. He enables the Universities to give a definite status and payment for any special educational work done out of the University under its control. Thus the funds of Oxford and Cambridge may be freely used in support of their missionary efforts in the large and neglected towns of England. There is no reason why permanent educational centres should not be established under this clause in any part of England. Any College with too much money can assign a sufficient portion of it to the advancement of learning in the neglected provinces. Leeds, Bristol, Birmingham, Halifax, Sheffield have had university men lecturing in their midst under the University Extension Scheme, and Lord Edmond Fitzmaurice's amendment invites the colleges to support and endow this movement. Under it the "idle fellows" who now run off to the bar will be drawn more and more into teaching, for teaching will open to them more and more of a career. No doubt there is risk that the possibility of such grants may paralyse local effort. But as yet it is only a possibility, and the colleges may be trusted to distribute their money only in places where adequate local effort cannot be expected. Another amendment by Mr. Trevelyan enables the Commissioners to review the conditions under which university emoluments can be given, especially those relating to age. There is no doubt that the age of undergraduates has increased, is increasing, and ought to be diminished. The honour man keeps back at his school as long as possible in order to make sure of getting his entrance scholarship. Even if the age at which entrance scholarships can be taken were restricted, honour men might in many cases delay so as to have a better chance after they come up of the scholarships and fellowships which are to be gained while in residence. It is reasonable to say that the work which a man is to do under the pressure of a prize examination *ought* to be over by twenty-one. What comes after is another matter. The competitions of the University imply a discipline which is admirable for youth "under tutors and governors," but which is merely fatiguing to men of mature intellect with serious objects in life.

A clause is to be brought up by Mr. Goschen on the report which provides that the Commissioners shall first publish the main outlines of their plans before they are allowed to apply them in detail. Certainly it seems odd that Parliament should consent to throw the whole of the questions affecting the Universities into the hands of any body of Commissioners without asking for some statement from them by which they may discover the general drift of their ideas and the character they propose to give their work. It is of great importance that before any one of them is dealt with the Colleges should know on what principles it is proposed to deal with all of them, and what are the objects to which, in the opinion of the Commissioners, the money taken should be applied. In an amusing letter to the *Pall Mall Gazette* a few days ago, Mr. Dodgson, of Christchurch, represents science at Oxford as first modestly asking endowment to enable her to teach, next claiming endowment for boys to be sent to her to be taught, and lastly demanding an endowment to enable her to "think." It is an amusing travestie of the claims of the more advanced and extreme "researchers," and it is natural to ask what is the view of the Commissioners on the subject.

Since Parliament separated for the Whitsuntide holidays two things have happened in Oxford, which indicate the drift of that University opinion which in the end controls the actions even of Commissioners. The first was the Oxford scheme for new professorships. It was an echo—certainly an exaggerated one—of a similar scheme proposed some time ago by some similar board of studies in Cambridge, and they both showed that the leading members of the two Universities are not indisposed to consider very large and radical schemes of reform. Both of them will give fresh strength to the party, more powerful perhaps in sympathy than in numbers, which is suspicious not merely of proposed researchers with nothing to do but "to think," but of possible professors with very few lectures to deliver, and still fewer students to hear them. It is the commonest and the most vulgar argument against such proposals that they are really drawn in the pecuniary interest of the class of actual and possible professors who are numerous in the Universities. The Hebdomadal Board shows us at any rate one distinct way in which it is possible to utilize the endowments of Oxford and Cambridge, and they put fairly before us the question whether it is not a better way than the prize fellowship system.

The second event of the past week was the discussion in congregation of the new resolutions on natural science degrees. It is proposed that instead of there being one kind of degree and only one—that in Arts—open to ordinary undergraduates, a new degree shall be created in Natural Science. The Bachelor of Arts has to pass three examinations, at which he has to show proficiency in Latin and Greek. It is proposed that the new Bachelor of Science should be let off with Latin or Greek, the missing classical language being replaced by German or French. The Bachelor of Science was meant to know more mathematics than the Bachelor of Arts, but the mathematical men have pressed the question whether mathematics itself is not a science, and whether mathematical honour men ought not to be let off as well as experimental men with one dead language. So far as things have yet shown, Oxford is in favour of the change, and eager to consider the case of the mathematicians. These are, in fact, the proposals of the Duke of Devonshire's Commission. We desire to speak with the greatest possible respect of those who maintain the *status quo* of the two classical languages, but it seems to us impossible to ignore the fact that the Greek learned by the pass man is about as much of a "possession for ever" as the Hebrew of most clergymen. It is begun late; it is not carried far enough to give the student any real pleasure in reading a Greek book for himself; it is thrown aside as soon as its use, which is solely a "pass" use, is over, and done with. Mr. Sidgwick says, with perfect fairness, that "the study of Greek is one thing, the knowledge of the *Alcestis* and the study of Mr. Bohn's translation of it another." That the University should have voted in this sense by sixty-three votes to forty, and expressed its desire to treat the mathematicians as entitled to a similar relief by twenty-seven to fourteen is a conclusive proof that the world moves even at Oxford. Many of those who are best acquainted with that University indeed declare that it is there only that it does move—at all events, that it is only there that it moves by "leaps and bounds," as British commerce used to do in the happy days of Mr. Gladstone's ministry! Certainly the votes of Oxford are often more liberal than those of London, and we cannot doubt that whenever the new Commission sets to work it will find as much impulse as obstruction from that great University. Of Cambridge itself it has ceased to be true to say that she maintains her usual attitude of magnificent repose. The universities are anxious to reform themselves if they only know how—the Commissioners will be happy to assist them if they only get power enough—and we may perhaps hope that a few "thinkers" may get something out of the reconstruction better than the very plain living with which their "high thinking" has hitherto been so commonly coupled.

THE NEED OF MUSEUM REFORM

FEW of the many subjects now pressing themselves on the attention of the public are more important than that of museums, of the work which they are doing now in general education, and what they may reasonably be expected to do in the future. It is one which has occupied my mind for many years, and on which I venture to offer the following remarks.

The collecting instinct, the desire to accumulate what strikes the fancy, is so universal in all minds lifted above the satisfaction of the mere animal needs, that its absence is to be viewed as an infirmity or misfortune analogous to colour blindness or deafness. It is present in some form or another in most savages, and even in some birds, such as the bower-bird. It is based ultimately on the principle of curiosity combined with that of selfishness. Poor and much to be pitied is the man who has it not. The collections which result from it bear the stamp of the individual who makes them, and are as various as his tastes. They may be conveniently termed museum units, which, like molecules, have a tendency to coalesce into bodies of greater or less size, and thus constitute museums. These are of high or low organisation according as the units keep or lose the stamp of the individual, and have been moulded into one living whole or are dissociated. They are highly organised and valuable if the parts are duly subordinated to each other and brought into a living relationship; they are lowly organised and comparatively worthless if they remain as mere assemblages of units placed side by side without organic connection and without a common life.

Unfortunately in this country the provincial museums mostly belong to this latter class. It is that which takes shelter for the most part in the top rooms of Mechanics Institutes and in the holes and corners of Free Libraries and Museums. In one instance which occurs to me, you see a huge plaster cast of a heathen divinity surrounded by fossils, stuffed crocodiles, minerals, and models of various articles such as Chinese junks. In another, a museum unit takes the form of a glass case containing a fragment of human skull and a piece of oatcake labelled "fragment of human skull very much like a piece of oatcake." In a third, wax models are exhibited of a pound weight of veal, pork, and mutton chops, cod fish, turnips, potatoes, carrots, and parsnips, which must have cost the value of the originals many times over, with labels explaining their chemical constitution, and how much flesh and fat they will make—just as if the public were unacquainted with those articles of food, and required any information as to what these names really cover. Strangely enough this museum unit appears modern. In very many museums art is not separated from natural history, nor from ethnology, and the eye of the beholder takes in at a glance the picture of a local worthy, a big fossil, a few cups and saucers, a piece of cloth from the South Seas, a war club or two, and very possibly a mummy. The result of such an association as this, of articles which have no sort of relationship with the rest, is to convert the whole into rubbish, using the word in the Palmerstonian sense of being "matter in the wrong place." I do not mean to say that museums of this low order are useless. In default of better they are useful, just in proportion as they encourage the collecting instinct in the beholders. They may ultimately arrive at the higher stage of development. It is, however, a reproach to this country that museums of this low type should be found at this time, not merely in the smaller towns, but in some of the more important centres of population. They constitute a serious blot on our educational system, which we are striving to make as perfect as possible, since they are worse than useless for purposes of teaching. Instead of the natural harmony of things, they put before the mind a fortuitous concourse of atoms which is a very chaos.

While this state of things prevails largely in this country, there is no room for astonishment that museums of natural history hold the position which they do hold in the public mind. They are looked upon as haunts of the mere specialist, and as altogether outside any scheme for the advancement of the higher studies. If they are sufficiently attractive to be visited, they are treated as places of amusement, in which "a happy day" may be spent, instead of places of instruction. They are sometimes avowedly arranged for that end. It rarely enters into any one's head that collections are as absolutely necessary for the advancement of natural history studies, as books to the literary student, though it is allowed on all hands that natural history is of great importance in general education. Until this anomaly be removed by the re-arrangement of the museums which require it, and the establishment of new ones, it is hopeless to expect the natural sciences to flourish as they should flourish, or for them to assume the importance which they deserve in the studies of this country. To the obvious remark that the fruits of English natural science are not worse than those of our neighbours, it may be answered that what has been done is the result of personal effort overcoming obstacles, and succeeding in spite of disadvantages. The fact that some men can swim does not render life-belts unnecessary for those who cannot.

Well-arranged museums of every kind are now an educational necessity in every highly civilised state, and everywhere excepting in our own they are put on exactly the same footing as libraries. They are to be seen in nearly every town of any pretension on the Continent, and in cities, such as Turin, Bologna, Lyons, Brussels, and Hamburg, they exist on a scale which is only rivalled by those of London. In the United States, also, and in Australia, their value to society at large is fully recognised. They are liberally supported and largely endowed. In no museum out of Britain have I seen the chaos from which our own are now painfully and slowly emerging.

There are many highly organised museums in Britain which perform their true function as repositories of knowledge, such as those at London and the Universities, those of Leeds, Liverpool, Bristol, Taunton, Exeter, Salisbury, and others. Their numbers must be largely increased if we are to hold our own in the race for knowledge with our neighbours on the Continent and our kinsmen in Australia and America.

W. BOYD DAWKINS

FOSTER'S "TEXT-BOOK OF PHYSIOLOGY"

A Text-Book of Physiology. By M. Foster, M.A., M.D., F.R.S., Prælector of Physiology, and Fellow of Trinity College, Cambridge. (Macmillan, 1877.)

PHYSIOLOGY, like most other sciences, has been making rapid strides within the last half century, and although scarcely yet to be classed among the exact sciences, the number of well-established facts which have been accumulated is not inconsiderable, and is in several cases sufficient to serve as a substantial foundation for the building up of more or less stable theories, and the enunciation even of tolerably fixed laws. Consequently it is to-day no longer necessary to urge the importance of the cultivation of physiological science as the basis of rational medicine. Not only is this fully recognised by the medical profession but there are distinct indications that the public in general is beginning to appreciate the importance of a correct knowledge of the normal processes which are going on within the body, preparatory to the recognition and cure of such deviations from the natural processes as constitute disease. And no wonder the science should be popular the object of which is to teach us how "we live and move and have our being!"

Students of physiology in this country have long needed an advanced text-book containing the leading facts and inferences of the science set forth at length and intelligibly, the statements and deductions which are less important or less clearly established being relegated to the background of small print, or even omitted altogether. The place of such a book was supplied in Germany by Hermann's "Grundriss der Physiologie," in every respect a model text-book, and one of which it is impossible to speak too highly; and it was hoped that the production last year of a translation of Hermann's work would meet the requirements of the English student. But whether simply from the fact of its being a translation or from other causes, certain it is that the book has not fulfilled the expectations which were entertained with regard to it. It is, therefore, a matter for sincere congratulation to physiologists that one in every respect so well qualified for the task as Dr. Michael Foster should have undertaken to provide what was so much needed in the way of a text-book, and also, it may fairly be added, to himself, that he should have brought the undertaking to so successful an issue.

Dr. Foster's aim in writing the book is best given in his own words:—

"I have striven to explain, in as clear and straightforward a manner as I could, the main facts and fundamental principles of physiological science. The student before whom things both new and old are tumbled out of the physiological treasury, without adequate critical appreciation of their respective values, is simply bewildered instead of being taught. . . . . And it is the duty of the teacher to bring his pupil to that which is fixed and sure, without too much display or too much neglect of that which is uncertain and loose. . . . . A desire to contribute, as far as my powers will allow, to the development of physiology in the medical profession has been my guiding principle in writing the book."

The style of treatment and the mode of thought pursued throughout are characteristic of the author, and serve to indicate the originality of the book, always one of the chief merits of a work of this sort. It is often thought that a scientific text-book need be little more than a museum of facts and opinions, carefully arranged and neatly labelled, to enable them the more readily to be "got up" by the student, in order that he may be able to satisfy an examiner with a narration of whatever has been stated or conjectured about any particular subject. Were this the case, the making of a text-book would be a mere matter of scissors and paste-brush, and the task could be performed by any one who was capable of reading the language of the science. That the idea is a wrong one is so self-evident that it would be waste of words to delay in refuting it. Even an elementary text-book is never so well done as when it is taken in hand by one who is a master in the science. There is a well-known instance in this particular science of physiology, and, in fact, it is to Huxley's "Lessons" that Dr. Foster wishes his book to be regarded as the sequel.

An indication of the original character of the book before us is to be found in the fact that it is not throughout equal. All the subjects are well done, but some are better treated than others, a result to be expected from the very extended nature of the science. No one—not even a Helmholtz—can pretend to an intimate personal acquaintance with all the branches of so ramified a science, and it is casting no slur upon the rest of the work to single out a section here and there, characterised by the especial clearness with which the known facts are stated and the phenomena are discussed and explained. The articles on the coagulation of the blood and on gastric and pancreatic digestion, and the chapter on the spinal cord, may be especially mentioned as illustrations of this.

Another and a more prominent indication of originality is occasionally met with in the descriptions of observable phenomena, facts being here and there noticed which are obviously the result of personal observation, and which have not hitherto so far as we are aware, been noted down. Thus in describing the phenomena of the heart's beat in mammals the contraction of the auricles is stated to be preceded by a peristaltic contraction of all the great veins which open into the heart. And there is no doubt that Dr. Foster is right in describing this as a distinct factor in the cardiac cycle.

The manner in which the nervous system is introduced to the student calls for special comment. In treating of the various phenomena of the circulation, respiration, secretion, &c,, frequent mention must necessarily be made of the relation of the nervous system to those functions. This pre-supposes a knowledge of the mode of origination and transmission of nervous impulses, and of the changes they may undergo in transmission, and hence of the fundamental properties of the nervous tissues. It might well, therefore, be deemed proper to commence a work on physiology with the account of a system which, in the higher animals at least, dominates and directs all the other functions. But on the other hand, from its greater intricacy, it is found in the teaching of physiology by far the most convenient plan to defer the account of the nervous system until the simpler, and more obviously physical phenomena of the living body have been dealt with.

Dr. Foster has got out of the dilemma in an ingenious and effectual manner. For whilst the account of the central nervous system and its principal instruments—the sense-organs—are reserved for one of the concluding chapters of the book, a short exposition of the fundamental properties of the nervous tissues, and also, but in very general terms, of the special functions of the chief nervous centres, is introduced at quite an early stage—a mode of dealing with the subject which enables such important questions as the influence of the nervous system upon the heart, respiration, secretion, &c., to be discussed at length with their respective subjects in place of being deferred until the end of the book. We are not sure that this introduction to the nervous system might not with advantage have come in even earlier than it does; as a sequel, in fact, to the chapter with which the work is introduced.

We quote a few passages from the prefatory article on the fundamental properties of the nervous system as yielding an illustration of the gradual, easy way in which Dr. Foster leads up to a difficult subject:—

"In its simplest and probably earliest form a nerve is nothing more than a thin strand of irritable protoplasm, forming the means of vital communication between a sensitive ectodermic cell exposed to extrinsic accidents, and a muscular, highly contractile cell (or a muscular process of the same cell) buried at some distance from the surface of the body, and thus less susceptible to external influences. If in hydra we imagine the junction of the ectodermic process with the body of its cell to be drawn out into a thin thread (as appears to be the case in some other hydrozoa), we should have just such a primary nerve. Since there would be no need for such a means of communication to be contractile and capable of itself changing in form, but on the other hand an advantage in its remaining immobile, and in its dimensions being reduced as much as possible consistent with the maintenance of irritability, the primary nerve would in the process of development lose the property of contractility in proportion as it became more irritable, *i.e.*, more apt in the propagation of the waves of disturbance arising within the ectodermic cell.

"We have already seen (introductory chapter) that automatism, *i.e.*, the power of initiating disturbances or vital impulses, independent of any immediate disturbing event or stimulus from without, is one of the fundamental properties of protoplasm. In simpler but less exact language, such a mass of protoplasm as an amœba, though susceptible in the highest degree to influences from without, 'has a will of its own.' . . . . A hydra has also a will of its own; and seeing that all the constituent cells are alike, we have no reason for thinking that the will resides in one cell more than in another. . . . In both hydra and amœba the processes concerned in automatic or spontaneous impulses, though in origin independent of, are subject to and largely modified by, influences proceeding from without . . . .

"The next step of development beyond hydra is evidently to differentiate the single (ectodermic) cell into two cells, of which one, by division of labour, confines itself chiefly to the simple development of impulses as the result of stimulation, leaving to the other the task of automatic action, and the more complex transformation of the impulses generated in itself. The latter, which we may call the eminently automatic cell, will naturally be withdrawn from the surface of the body, while the other, which we may call the eminently sensitive cell, will still retain its superficial position, so that it may most readily be affected by all changes in the world without. And just as a primary *motor* nerve arises as a retained thread of communication between a sensitive cell and its own muscular process, so a primary *sensory* nerve may be conceived of as arising as a thread of communication between an eminently sensitive cell, and its twin the eminently automatic cell. . . . . Naturally the muscular process or muscular fibre would, on the splitting of the original single cell, remain in connection with the most eminently automatic. We thus arrive at that triple fundamental arrangement of a nervous system in its simplest form, viz., a sensitive cell on the surface of the body connected by means of a sensory nerve with the internal automatic central nervous cell, which in turn is connected by means of a motor nerve with the muscular fibre-cell. . . . ."

In the introductory chapter of the book the physiological processes which occur in the amœba are described, and these are taken as the basis upon which the whole superstructure of the science is to be built up. This is a wise course to pursue, for in a work on physiology the amœba cannot have too prominent a place assigned to it. It is over the amœba that the battle of physiology must eventually be fought out.

The chief organic compounds met with in the animal body are considered together in an appendix, which has evidently been carefully drawn up, and will be found not the least useful portion of the book. It is, no doubt, an advantage in many respects to have a series of similar facts thus collected and put on one side for reference. At the same time it may be questioned whether in the case of some of the bodies which have been relegated to this situation—the constituents of the blood and urine, for example—it would not have been better rather to have awarded them somewhat greater prominence in the parts of the book which treat of the special fluids or secretions in which they occur. A frequent reference to the appendix in such places might answer the purpose.

It is pleasant in a book of this sort to be able to find so little that is open to adverse criticism. It is true the latter part of the work bears traces of haste, and one or two important subjects are somewhat lightly dealt with. Moreover here and there statements which are anything but "fixed and sure" are to be found clothed in large type, while others, which are based upon a large number of exact experiments (the observations of Ludwig and

Woroschiloff upon the paths of conduction in the spinal cord, for example), are confined to small print. Exception might also be taken to the somewhat dogmatic decision of an undecided question, such as that of the cause of the pulse-dicrotism. And it may be doubted whether the introduction, if not of pictures, at least of a greater number of diagrams, would not render some of the subjects easier to the comprehension of the student. But looked at as a whole, the book must be pronounced thoroughly well done, admirably adapted for its purpose, and creditable alike to its author and to the science which it is intended to promote. E. A. SCHÄFER

WEISBACH'S "MECHANICS OF ENGINEERING"

A Manual of the Mechanics of Engineering, and of the Construction of Machines, with an Introduction to the Calculus, by Julius Weisbach, Ph.D. Vol. I.—Theoretical Mechanics. Translated from the Fourth Augmented and Improved German Edition, by Eckley B. Coxe, A.M. (London: Trübner and Co., 1877.)

THERE is, perhaps, no book on mechanics so well suited to the wants of civil and mechanical engineers as the late Dr. Weisbach's "Lehrbuch der Ingenieur und Maschinen-Mechanik." In his preface to the first edition of his work the author thus stated his design (we quote from the translation before us):—

"My principal effort has been to obtain the greatest simplicity in enunciation and demonstration, and to treat all the important laws in their practical applications without the aid of the higher mathematics. If we consider how many subjects a technical man must master in order to accomplish anything very important in his profession, we must make it our business as teachers and authors for technical men to facilitate the thorough study of science by simplicity of diction, by removing whatever may be necessary, and by employing the best known and most practicable methods. For this reason I have entirely avoided the use of the calculus in this work. Although at the present time the opportunities for acquiring a knowledge of it are no longer rare, yet it is an undeniable fact that unless we are constantly making use of it, we soon lose that facility of calculation which is indispensable; for this reason so many able engineers can no longer employ the calculus which they learned in their youth. As I do not agree with these authors who in popular treatises enunciate without proof the more difficult laws, I have preferred to deduce or demonstrate them in an elementary, although somewhat in a roundabout manner."

Weisbach was severely censured by some people for attempting to treat his subject without the higher mathematics, but he kept to his own way, saying that he intended his work not as a university text-book, but only for "practical men." In the later editions of his work, however, he gave additional demonstrations of some of the laws by the differential and integral calculus, on which he also added an introductory chapter, which surpasses in clearness anything we have seen on the subject. In judging of Weisbach's method we must not forget that few men had so much experience in teaching practical engineers, and that no one had a better knowledge of what such men really require; and we must at least acknowledge that, although in some few cases he may have carried his system too far, and have sacrificed scientific exactness of expression to mathematical simplicity, if he erred, he did so on the right side. Most English authors of books on mechanics and kindred subjects seem to forget how small is the amount of mathematical knowledge possessed by the average engineer. In the rising generation of engineers this is no doubt changing for the better, but there are still many in this country—men of ability and men who have executed works which do credit to the nation—whose ideas of the differential and integral calculus are vague in the extreme, and it is satisfactory that there is at last a standard work for their use.

The work appeared originally in two parts. The first "Theoretische Mechanik," and the second, "Statik der Bauwerke und Mechanik der Umtriebsmaschinen." To these was afterwards added a third, "Mechanik der Zwischen und Arbeits-Maschinen." The volume before us is a reprint of an American translation of the fourth German edition of the "Theoretische Mechanik." This edition was published in 1863. In 1875, after the author's death, a fifth edition was issued, which differs to a small extent from the fourth. It contains a chapter on springs, taken principally from Reuleaux's "Construction und Berechnung der für den Maschinenbau wichtigsten Federarten;" another on the general principles of dynamics, also, in the Appendix, "The Elements of Graphical Statics," none of which are in the fourth edition. We regret that the chapter on graphical statics was not added to the translation. The graphical method seems likely to come more generally into use, and a short introduction to it, giving the general rules for its application to statics, and showing the manner of using it, would have added to the value of the book.

Mr. Coxe has done the work of translation carefully, and, on the whole, well. He has avoided the blunders made by the author of the former translation, and he has given a faithful rendering of the German. He uses, however, many terms which are not in use in this country, and we are sorry that they are far from being improvements. He talks, for example, of the centre of gravity of lines and geometrical figures, of "living forces" (surely *vis viva* was quite bad enough), &c. There is room for difference of opinion as to whether Mr. Coxe has done wisely in retaining the various tables in the book on the metric system.

This translation is wonderfully free from misprints, and most of those which do exist are quite apparent. On p. 479, for example, we find the following:—"REMARK.—Under the supposition that the proof strength increases and decreases with the ultimate strength, the English engineers increase the size of that portion of cast-iron girders which is subject to *compression*," &c. (the italics are ours). On p. 121, § 21, $v = \frac{\sigma}{\tau}\left(\frac{ds}{dt}\right)$ should be: $v = \frac{\sigma}{\tau} = \frac{ds}{dt}$, and "The element of time $\tau\ (dt)$" should be: The element of time $\tau = dt$. On p. 291, § 157, we have: "From this we obtain $QR = \overline{OR}.\tan.\phi = \overline{OR}$." Then on the line below "$\frac{y}{b}.\frac{V}{H}$, which is the difference," &c. This should be $QR = OR.\tan.\phi = OR.\frac{y}{b}.\frac{V}{H}$.

Weisbach's name is known in this country principally in connection with hydraulics. In this branch of mechanics he was a most laborious experimentalist, and he obtained many valuable results, many of which are incorporated in the work before us. In this first volume of his work the discharge of water is very fully treated. Unfortunately, however, his so-called theoretical formulas belong to the same category as those which Prof. James Thomson of Glasgow showed in his paper, read before the last meeting of the British Association, to be founded on assumptions which are not in accordance with known hydrodynamic principles.

On page 851 of this translation there is a formula to which we would draw attention. It is taken from "The Lowell Hydraulic Experiments," by J. B. Francis, and is for the discharge of water over a weir. This formula is "$Q = 3{\cdot}33\ (l - 0{\cdot}1\ nh)h^{\frac{3}{2}}$ English cubic feet, in which h denotes the head of water above the sill of the weir, l its length, and n either 0 or 1 or 2, according as the contraction of the vein is prevented upon both, one, or none of the sides." Prof. Thomson, in the above-mentioned paper, referred to this formula as identical, in its general form $a\,(l - \beta\,n\,h)h^{\frac{3}{2}}$, with the one which he had deduced from known principles as the true theoretical formula. Mr. Francis put it forward merely as an empirical formula which agreed with the results of his experiments, and it is curious that he should have made a guess which turned out to be more in accordance with the true theory, than all the previous so-called theoretical formulas, which had been advanced and sanctioned by the best authorities.

PATRICK EDWARD DOVE

OUR BOOK SHELF

A General Dictionary of Geography, Descriptive, Physical, Statistical, Historical; forming a Complete Gazetteer of the World. By A. Keith Johnston, F.R.S.E. New edition, thoroughly revised. (London: Longmans and Co., 1877.)

THE title of this work is somewhat misleading. The "physical" and "historical" elements are so meagre that they are scarcely worth mentioning as features of the work. To call this a "*complete* gazetteer of the world" is a misuse of the term "complete;" *incomplete* would have been more accurate. Even on the scale of the present work it would take a gazetteer at least three times its size to contain anything like a register of all the places one would naturally expect to find in a "complete" gazetteer. The work includes a selection of the more important places in the world, very few towns, for example, out of the United Kingdom being given, whose population is under 1,000. We find no fault with the publication of a selective gazetteer, but it should not pretend to be more than it is. When compared with Ritter's well-known work, *e.g.*, the proportion of places found in the latter as compared with "Johnston" is something like five to one. We believe a service would be done to the public by the issue of a gazetteer containing simply all the names omitted in "Johnston." It is not for well-known places we turn up a gazetteer, but for names that one seldom hears. During these Eastern troubles, how many names of places not to be found in "Johnston" have become of great importance, and during the war just begun how many more are likely to come prominently into notice? On the other hand, much valuable space is occupied with catalogues of streets and public buildings in the articles devoted to well-known places like London, Edinburgh, Paris, Vienna, &c. All that can be said about public buildings and similar features of a town in a gazetteer of this scale is practically useless; the space would be used to much better purpose by an enlargement of the list of names. In Russia, for example, nearly all "towns" and "villages" seem to be omitted, many of them with thousands of inhabitants, only "district towns," as a rule, being given. Poland and Finland are also very unsatisfactory; in fact these countries have never been properly "gazetteered" even in Russia. In several instances the "latest" information has evidently not been obtained. To get it, indeed, would involve a vast amount of research among official publications and travellers' narratives, but in a standard work such research is demanded. In Switzerland, we are informed by a Swiss friend, much of the information is half a century behind date. Under Chaux-de-Fonds, *e.g.*, the statement with regard to the manufacture of chains for the movements of watches has not been true for at least thirty years; and there is no lace now made at St. Imier. To arrange the wealth of information published by the United States Survey alone would involve much time and labour; we fear that for the new edition this has not been thoroughly done. Nearly two years ago Mr. W. H. Dall, of the United States Coast Survey, published a Report on the mountains in the Alaska territory. Yet no use has been made of this Report though it is quite accessible. For Mount St. Elias the height in the English Admiralty Chart, 14,970 feet is given, instead of upwards of 19,000 feet, obtained by the careful measurement of the United States Survey in 1874. The height of Mount Fairweather is set down as 14,708 (1855) instead of 15,500 (1874); Mount Crillon 13,500 instead of 15,900; Mount Cook 16,000, Mount La Perouse 11,300, and Mount Vancouver 13,100 feet, are not given. Such imperfections make one doubt if this new edition has been "thoroughly revised." It is easy to give information contained in census tables and in other gazetteers and guide-books, but even a work on the limited scale of the present cannot be made throughout trustworthy without very considerable trouble being taken.

Zoological Classification. By F. C. Pascoe, F.L.S. (John Van Voorst, 1877.)

THIS small work will be found particularly serviceable to many working naturalists. It is a concise compilation of the sub-kingdoms, classes, and orders of the animal kingdom, with lists of the families and most important genera. Specialists will be able to find fault with some of the details in many cases, nevertheless we know no volume which, in the space, contains so much reliable information. The larger groups are all succinctly defined, with many of the most modern views incorporated; and these definitions extend to the orders. Taking the mammalia for criticism, we regret to find the Sirenia included with the Cetacea, the Musk Deer with the Chevrotains, the Peccaries with the true Swine, and the Camels between the Giraffe and the other typical ruminating animals. The caccum is not "enormous" in Hyrax. "Whatever gaps there may be at the present day" between the Perrissodactyla and Artiodactyla "are *not* nearly all filled in by numerous extinct forms." Such errors may be found in many places; they do not, however, much detract from the general value of the work, which will be found more valuable as a basis for annotation, than a book of reference. There is a very complete index we are glad to say.

Tracts relating to the Modern Higher Mathematics. Tract No. 2, Trilinear Coordinates. By Rev. W. Wright, Ph.D. 77 pp. (London: Messrs. C. F. Hodgson and Son, 1877.)

DR. WRIGHT is, or was until quite recently, Professor of Mathematics at Wilson College, Pennsylvania. His object is to make his countrymen acquainted with certain branches of modern mathematics, and we learn that his first venture (Tract No. 1, *Determinants*) has met with considerable acceptance in the American universities. M. Hermite, too, has expressed himself well pleased with the author's standpoint, "Une grande transformation s'est déjá faite et continue encore de se faire dans le domaine de l'analyse; des voies nouvelles plus fécondes, et je crois aussi plus faciles, ont été ouvertes, et c'est l'œuvre de ceux qui veulent servir la science et leur pays de discerner ce que les éléments peuvent recevoir de l'immense élaboration qui s'est accomplie depuis Gauss jusqu'à Riemann."

There is in the present tract a clear exposition of the elementary applications of Trilinear and Triangular Coordinates, and just a passing glance at Polar reciprocals.

In such a work we do not look for anything original, but for clearness and correctness. These ends, we think, have been attained, and we wish Dr. Wright health and leisure to enable him to carry out his design.

Grundriss der chemischen Technologie. Von Dr. Jul. Post. (Berlin: Robert Oppenheim, 1877.)

DR. POST, who is known to chemists as an able Privat Docent at the University of Göttingen, has, like many other teachers, felt the great necessity of a manual of chemical technology, suited to the requirements of students who desire a general training in that branch of applied chemistry. A considerable number of excellent treatises, as, for example, those of Knapp, Wagner, Bolley, Kerl, and Stohmann, already exist in German, and some of them have been translated into English, but no one of them is exactly adapted to the class-room. Their excellence consists in their completeness as works of reference; indeed as such they may be said to be invaluable to the chemical manufacturer; but the mode of their arrangement renders them of comparatively little value as aids to systematic study. Dr. Post has succeeded in producing a work which, within the compass of some of our smaller chemical manuals presents a complete outline of the present position of chemical technology. His book thus serves as a fitting introduction to the larger and more special treatises above mentioned.

LETTERS TO THE EDITOR

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

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

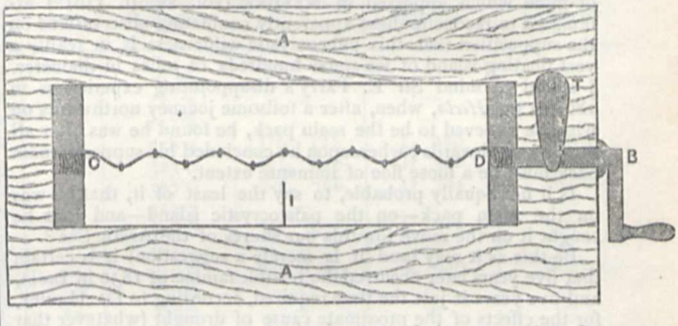
Colour-Sense in Birds

I HAVE been lately watching, with great delight, two goldfinches building their nest. They placed it nearly at the end of an outside branch of a young sycamore tree, so that there was nothing but sky above it, and the gravel path below. The window from which I observed them, being never opened, and well covered with flowers in pots and a blind, seems to have caused them no alarm, although not more than two yards distant from them; and their object appears to have been to make their nest invisible from below. To this end they chose their building materials with such skill and such colour-matching power that if one had not seen the nest built it would be quite impossible to discover it; to match the tree they took its long flexible blossoms, and to match the sky the equally long and flexible stalks and flowers of the garden forget-me-not, of which a bed was close at hand in full bloom. I watched them carefully, and, as far as I could see, they used no other materials than these flowers, though I saw one of them *attempting* to get the dirty-white cotton tie off a budded rose-tree. At all events the nest was mainly built of them. The blue of the forget-me-not has of course faded, but the general effect from below is that of a scarcely visible grey-green thickening of one of the bunches of sycamore leaves. They seemed to enjoy flinging their flower-wreaths about. And that leads to the question whether birds—who are in many ways like children—do not often out of mere playfulness and love of colour, pull to pieces yellow crocuses and other bright flowers. While my pen is in my hand I may mention, with reference to Dr. Muirhead's communication on the subject of noise causing a sensation of colour, that I have frequently observed whilst tuning a harp, that the sudden breaking of a string will cause a curious *taste* and sensation in the mouth, like that produced by a piece of silver and one of zinc placed above and beneath the tongue, when they are made to meet. J.

A Simple Wave-Motion Apparatus

IT has been suggested to me that I should publish a description of a simple and portable wave-motion apparatus, devised by me a year or two ago, which has given satisfactory results to others as well as to myself. I therefore send the description.

In the figure A A represents an ordinary wooden lantern slide, with a rectangular aperture, which may vary in size according to the size of the lantern condensers, the sketch being half size for 4-inch condensers. A small winch, B, is fitted into the slide at one end of the aperture, and held in its place by the tongue, T. The spindle, B D, is milled or otherwise roughened near the end, D. A brass stud similar in shape to the milled end of the spindle, but *smooth* and slightly smaller, is fixed in the opposite side of the aperture at C. A helix of 25-gauge hard brass wire is wound on a spit of the same size as the smooth stud, taking care to wind the coils close together; about fifteen turns of the helix are cut off, and the middle five turns drawn out till they form a perfect wave similar to the figure when held up to the light. The length of the helix should then be the same as C D. One end of the helix is pushed tight on the milled end, D, and the other end is slipped loosely over the stud, C, so as to work



on it like a swivel, to keep the end of the helix true when the winch is turned. A little bead of wax is melted on each crest and hollow of the wave to represent particles, and the essential parts of the apparatus are complete. On placing it in front of the lantern, and focussing, a distinct and striking image of a moving wave with its vibrating particles is produced by turning the winch.

If the helix is not perfectly straight the image of the wave will rise up and down more or less as a whole; the helix should then be straightened or "set" with the fingers till true. When once set thin glass plates may be placed on each side to protect it from injury. An index, I, of wire, may be fixed so as to give a means of proving that the particles *only* move up and down.

A modification I have tried by using a dark wire with bright silver beads, on a velvet back-ground in the aphengescope, is more difficult to make and use. I therefore prefer the apparatus as sketched above.

Of course the amount of finish depends on the taste of the user, &c. A pasteboard frame instead of mahogany, a wire bent twice at right angles instead of a finished brass winch, and tied to the frame by two bits of wire instead of let in, &c., may be used, thus reducing the cost to a few halfpence.

In use it will recommend itself. W. JESSE LOVETT

Birmingham

Atmospheric Currents

A CONTROVERSY was recently waged in your columns as to the course which is pursued by the hot water-laden air of the equatorial regions in its journey to the poles. Both combatants seem to adopt what I may call the sheet-theory, which regards the winds as moving in sheets or strata, and gliding over and under each other at the polar and equatorial sides of the calms of Cancer and Capricorn, a process which would inevitably result either in both opposing winds being torn to tatters, or in their commixture and neutralisation. Surely the truth is that like all other moving fluids, the air will seek equilibrium in the direction of least resistance, and will carve out for itself wide channels in accordance with local conditions from the poles to the equator, and from the equator to the poles—channels which will not intersect or interfere with one another, except when affected by disturbing causes.

One possible cause of change in this direction of least resistance or normal channel in the case of the south-west wind of these latitudes may possibly be a shifting of the thermal pole. Suppose, for instance, we have any reason to surmise that the centre of greatest cold is now on the American side of the true North Pole and at another time on the Asiatic side, we have at once a satisfactory explanation of observed variations in the prevalent direction of the main channels of the water-laden winds of the northern hemisphere.

I will now as briefly as possible state my reasons for suspecting that such is actually the case.

Since 1873 the south-west winds have prevailed very considerably over the average in Europe, and as a natural consequence we have had continued floods all over the west of this continent. In Asia, during the same period the water-laden winds have been fearfully under the average, the rainfall during the last three years having been about nine inches below the average of the previous half-dozen. Famines, of course, have been the result.

If my theory is correct we should expect to find that the thermal pole has been situated during the last three or four years on our own side of the North Pole.

Now in 1872 Capt. Hall, of the *Polaris*, saw unmistakable signs of an open polar sea where Capt. Nares, in 1875, saw nothing but a vast wilderness of ancient ice. In a former letter of mine which appeared in NATURE (vol. xv. p. 116) I attempted to reconcile these apparently conflicting observations on the supposition that this palæocrystic wilderness is in reality a vast floating island of ice some hundreds of miles in diameter. I called to mind Sir E. Parry's disappointing experiences in 1827 in the *Hecla*, when, after a toilsome journey northwards on what he believed to be the main pack, he found he was after all drifting southwards; whereupon he concluded his supposed main pack must be a loose floe of immense extent.

Is it not equally probable, to say the least of it, that he was on the main pack—on the palæocrystic island—and that he caught it on the move towards our shores of the Arctic Sea?

Be this as it may (and it is merely a suggestion) it is certain that five years later occurred the terrible famine of 1832 in India, and five years is just the time required, according to Dr. Hunter, for the effects of the proximate cause of drought (whatever that may be) to attain its maximum, according to the law of the "multiplication of effects."

Although I have examined the records of the winds at the Meteorological Office, I will add nothing more, as I fear I have already exceeded my proper limits.

WORDSWORTH DONISTHORPE

Yellow Crocuses

A LETTER in NATURE (vol. xvi. p. 43) calls attention to the destruction of the flowers of the yellow crocus by the sparrow. I have for many years been a cultivator of the crocus, both yellow, white, and purple; this spring they flowed abundantly, the white and purple blooming undisturbed, the yellow picked and torn. My gardener and I talked the matter over but could find no solution of the problem. As this has been my experience in former years, and the fact is now corroborated by general experience, can no naturalist discover the reason, or must it still be left a secret in the bosom of pert little *Fringilla domestica?*

A. H.

Complementary Colours

IN connection with this subject, which was referred to in Mr. Terrill's letter in NATURE for May 17, perhaps the following homely way of illustrating the fact that the combination of two complementary colours produces white may interest your readers. If a tumbler of beer be held in front of the green glass shade of an ordinary reading lamp, it will be found on looking through the beer at the shade that the tumbler appears to be filled with an almost colourless liquid.

J. ROMILLY ALLEN

Chromatic Aberration of the Eye

THERE is a slight inaccuracy in your report of my communication of May 12th to the Physical Society, wherein I am made to affirm that a blue object and a red object cannot both be in focus at once unless the blue object be the more distant. The next sentence of your report, and indeed the whole tenor of my communication imply the reverse condition, that the blue rays should come from the *less* distant source. The dispersion of the eye takes place in the same sense as its refraction; hence the adjustment of the eye to focus may be the same for blue rays proceeding from a body near the eye as for red rays proceeding from an indefinitely distant luminous source; as, indeed, Fraunhofer proved half a century ago.

S. P. THOMPSON

University College, Bristol, May 25

A Correction

PERMIT me to explain that the subject of my note, read at the last meeting of the Astronomical Society, was not my chart of 324,912 stars, though I had occasion in the course of it to mention that chart. My note referred in reality to a paper read at the preceding meeting, and relating to the general subject of the distribution of stars in space.

RICHARD A. PROCTOR

DR. PHILIP P. CARPENTER

WE regret to announce the death at Montreal, in his fifty-eighth year, of Dr. Philip P. Carpenter, formerly of Warrington, one of the most scientific conchologists of our time. Taking up this pursuit, in the first instance, merely as a recreative occupation, he was led by his friend, Dr. J. E. Gray, who saw his remarkable aptitude for it, to make it one of the principal objects of his life; and he brought to it a mind trained in those scientific habits which prevented him from ever becoming the mere species-monger, whilst specially delighting in that study of minute detail which is required for the true determination of specific types and their geographical distribution. It was well observed by Dr. Hooker, in his introductory essay to the "Flora of New Zealand," that "a wider range of knowledge and a greater depth of study are required to prove those dissimilar forms to be identical, which any superficial observer can separate by words and a name;" and this wide range of knowledge and thoroughness of research were the essential characteristics of all Dr. P. P. Carpenter's conchological work. The opportunity having occurred to him more than twenty-five years ago, while residing at Warrington, of studying a large collection of shells formed at Mazatlan, in California—after Mr. Cuming had selected from it what he considered the new specific types, which he caused to be described by Mr. C. B. Adams—Dr. P. P. Carpenter was impressed with the fact that Mr. Cuming had left behind him those *intermediate* forms, the study of which would prove that many of his supposed species are mere varieties; and having brought the importance of such study before the Zoological Section of the British Association, he was requested to prepare a report on the present state of our knowledge with regard to the mollusca of the west coast of North America, which was published in the *Transactions* of the Association for 1856, and at once took rank as a most able and conscientious work. A Supplementary Report on this subject, marked by the same "wide range of knowledge and depth of study," was published in 1863. Besides these, several monographs, prepared by Dr. P. P. Carpenter on particular groups of shells in the Cumingian Museum, were published in the Zoological *Proceedings*. So high was the reputation which his Reports acquired for him among American naturalists that he was invited by Prof. Henry of the Smithsonian Institution at Washington to assist him in the arrangement of its national collection of shells; and having been led in 1865 to take up his residence in Montreal, he was subsequently engaged in similar work for other museums in the Northern States. He soon acquired in the city of his adoption the character he had left behind him in Warrington, of being ever ready for any kind of philanthropic labour; and especially distinguished himself by his untiring advocacy, through evil as well as good report, of the sanitary reforms which he saw to be greatly needed. There is reason to believe that the typhoid fever which brought his useful life to a close was engendered in the foul air of the building in which he was accustomed to carry on his scientific work.

KOENIG'S TUNING-FORKS AND THE FRENCH "DIAPASON NORMAL"

HAVING had occasion to measure a series of Koenig's tuning-forks, kindly lent me for that purpose by Professors Tyndall and Guthrie, by means of Appunn's tonometer, now in the South Kensington Museum, I was much struck, and for a time puzzled, by finding that though the forks were perfectly consistent with each other, they did not answer to their names, that is, the numbers of single vibrations marked on them, did not answer at all to the double vibrations measured by Appunn's tonometer. The workmanship of Koenig's forks is so good and the intervals between them so exact, that one might be at first inclined to suspect the accuracy of the absolute numbers of the reeds on Appunn's instrument. But there can be no doubt of the accuracy of the differences of the number of vibrations between any reed and any other, for these admit of ready control by counting, and I have counted them all. Hence such a thing as this is quite certain. The difference of the vibrations of C 256 and G 384 is 128 vibrations, as on Appunn's instrument; but the difference in the vibrations of Koenig's corresponding forks is 129·2 vibrations. Now, I have no doubt about the perfection of Koenig's fifth C to G. If then his C make x vibrations, his G makes $x + 129{\cdot}2$ vibrations. Putting this $= \frac{3}{2}x$, we obtain $x = 258{\cdot}4$ as the number of the vibrations of his C, and this is the precise number furnished by Appunn's tonometer, according to a very careful measurement made by Mr. A. J. Hipkins, of Messrs. Broadwoods, who has had great experience in counting beats, and myself. The discrepancy, therefore, becomes an excellent proof of the perfection of Appunn's instrument. But how could Koenig have hit on this strange number 258·4, in lieu of 256? It was some litttle time before the solution presented itself to my mind, but I believe that this, which is decidedly sufficient, will prove substantially correct.

The French normal A was settled at 435, and since Lissajous superintended the publication of the fork of the French Commission in 1859, the whole world has accepted that fork as having exactly 435 vibrations. Now the French Commission gave to Messrs Broadwoods, in return for their courtesy in sending them their forks, an authorised copy of this fork, stamped with their stamp (a lyre between D and N, at the end of each prong) and made by Secretan. This fork I assume to be an authentic representative of the French diapason normal, made at the time. I have examined many others made by Secretan, and also officially stamped, and one by Koenig, and they mostly agree within two- or three-tenths of a vibration in a second. Two of Secretan's, however—one bought in Paris by the Society of Arts, and one sent to that society officially in 1869 through the Foreign Office, as representing the French pitch used in the Grand Duchy of Baden, differ as much as six-tenths of a vibration, the extreme difference observed in authorised forks. Other copies differ as much as two vibrations. But I take as my standard the copy given to Messrs. Broadwoods (which through the kindness of Mr. Hipkins I have carefully measured), and the one made by Koenig (which Dr. W. H. Stone was so obliging as to allow me to measure). These differ only by *one*-tenth of a vibration, and that tenth may be my own fault in counting. All these forks show that the real French diapason normal is A 439, that is, four vibrations sharper than was supposed. This is really a result of prime importance as brought out by Appunn's instrument, and it fully accounts for Koenig's differences as follows:—

Koenig having to make a C 256, observed (I suppose) that a major sixth above it would be A $426\frac{2}{3} = \frac{5}{3} \times 256$, and that this would beat $8\frac{1}{3}$ times in a second with A 435, which he assumed to be given by his diapason normal. Constructing such a fork by beats, which is easy enough, he necessarily obtained one exactly four vibrations too sharp, that is, A $430\frac{2}{3}$. From this, by the Lissajous figures most probably (certainly *not* by interposing new forks and counting the beats, for that would have shown him his error), he obtained first the correct major sixth below it, C $258{\cdot}4 = \frac{3}{5} \times 430\frac{2}{3}$, and then got his other forks by true intervals obtained also by Lissajous' figures. This makes all Koenig's forks harmonics of C 64·6, instead of C 64, as he intended and as he marks his forks.

Since Koenig's forks are extensively used by physicists, and also for the purpose of obtaining other pitches from them either for musical or for counting purposes, I think it will be convenient to add a little table of the harmonics of 64·6, with the marks on the forks observed (all of which had Koenig's monogram) and the pitches as actually measured by Appunn's tonometer. I am quite willing to allow the small differences to be set down to my bad counting and not to defective workmanship of either Koenig or Appunn.

No. of Harmonic.	Double Vibrations of Harmonic.	Marks on Koenig's Forks, V.S.	Meaning in English Notation.	Measured by Appunn's Tonometer.
1	64·6	—	—	—
2	129·2	—	—	—
3	193·8	—	—	—
4	258·4	Ut_3 512	C 256	258·4
5	323·0	Mi_3 640	E 320	323·1
6	387·6	Sol_3 768	G 384	387·6
7	452·2	—	—	—
8	516·8	Ut_4 1024	C 512	516·7
9	581·4	—	—	—
10	646·0	Mi_4 1280	E 640	646·0
11	710·6	—	—	—
12	775·2	—	—	—
13	839·8	—	—	—
14	904·4	7. 1792	B *flat* 896	905·0
15	969·0	—	—	—
16	1033·6	Ut_5 2048	C 1024	1033·6
17	1098·2	—	—	—
18	1162·8	Re_5 2304	D 1152	1163·3
19	1227·4	—	—	—
20	1292·0	Mi_5 2560	E 1280	1292·0

The last four forks were difficult to measure. Those left blank were not found either at the Royal Institution or the School of Mines. The 11th, 13th, 17th, and 19th harmonics would not be easy to tune by Lissajous' figures. Appunn's instrument gives them with perfect ease. I may observe here with regard to the question of forks and reeds, that though forks may be the most permanent and portable records of pitch, reeds have a great advantage in the number of their upper partial tones, which allow of an extraordinary variety of verifications without any assistance beyond the instrument itself. I have found this reed tonometer easily checked and invaluable in measurements. But the above table would allow any tuning-fork maker to tune exactly to C 256, or from C 254 to C 265, by means of beats from Koenig's forks.

In trying forks to-day at King's College, Prof. Adams drew my attention to the fact that Koenig's organ-pipes are much flatter than his forks. On account of the difficulty of getting a steady blast on the organ pipes, it was not possible to measure them satisfactorily by Appunn's tonometer (a copy of which is in the physical laboratory there, and should be in all physical laboratories, as it is the best instrument for illustrating the nature of sound, partials, beats, and chords that I have yet seen), but they seemed to give very nearly C 250, about eight vibrations flatter than the forks. I cannot account for this, as this would be about Koenig's 248. ALEXANDER J. ELLIS

Kensington, May 18

HOW TO DRAW A STRAIGHT LINE[1]

II.

IN Fig. 6, Q C is the extra link pivoted to the fixed point Q, the other pivot on it C, describing the circle O C R. The straight lines P M and P′ M′ are supposed to be perpendicular to M R Q O M′.

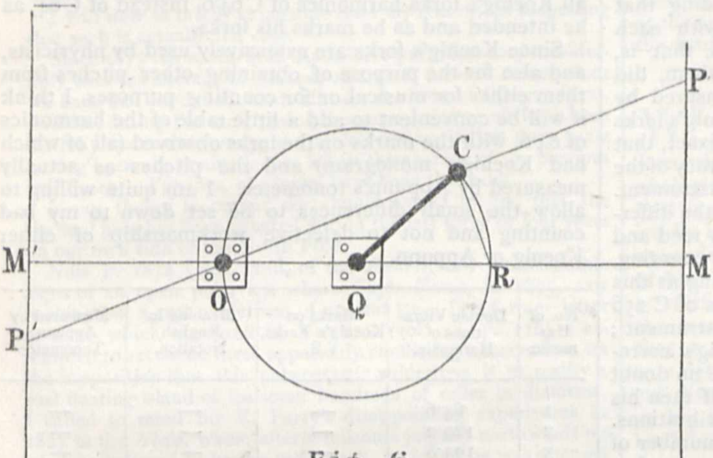


Fig. 6.

Now the angle O C R, being the angle in a semicircle, is a right angle. Therefore the triangles O C R, O M P are similar. Therefore,

$$OC : OR :: OM : OP.$$

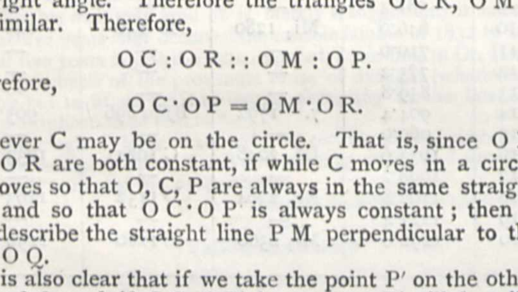
Therefore,

$$OC \cdot OP = OM \cdot OR.$$

wherever C may be on the circle. That is, since O M and O R are both constant, if while C moves in a circle P moves so that O, C, P are always in the same straight line, and so that O C · O P is always constant; then P will describe the straight line P M perpendicular to the line O Q.

It is also clear that if we take the point P′ on the other side of O, and if O C · O P′ is constant P′ will describe

Fig. 7.



the straight line P′ M′. This will be seen presently to be important.

Now, turning to Fig. 7, which is a skeleton drawing of the Peaucellier cell, we see that from the symmetry of the construction of the cell, O, C, P, all lie in the same straight line, and if the straight line A n be drawn perpendicular to C P—it must still be an imaginary one, as we have not proved yet that our apparatus does draw a straight line—C n is equal to n P.

Now,

$$OA^2 = On^2 + An^2$$
$$AP^2 = Pn^2 + An^2$$

therefore,

$$OA^2 - AP^2 = On^2 - Pn^2$$
$$= [On - Pn] \cdot [On + Pn]$$
$$= OC \cdot OP.$$

Thus since O A and A P are both constant O C · O P is always constant, however far or near C and P may be to O. If then the pivot O be fixed to the point O in Fig. 6, and the pivot C be made to describe the circle in the figure by being pivoted to the end of the extra link, the pivot P will satisfy all the conditions necessary to make it move in a straight line, and if a pencil be fixed at P it will draw a straight line. The distance of the line from the fixed pivots will of course depend on the magnitude of the quantity $OA^2 - OP^2$ which may be varied at pleasure.

I hope you clearly understand the two elements composing the apparatus, the extra link and the cell, and the part each plays, as I now wish to describe to you some modifications of the cell. The extra link will remain the same as before, and it is only the cell which will undergo alteration.

If I take the two linkages in Fig. 8, which are known as the "kite" and the "spear-head," and place one on the other so that the long links of the one coincide with those of the other, and then amalgamate the coincident long links together, we shall get the original cell of Figs. 5 and 7. If then we keep the angles between the long links, or that between the short links, the same in the "kite" and "spear-head," we see that the height of the "kite" multiplied by that of the "spear-head" is constant.

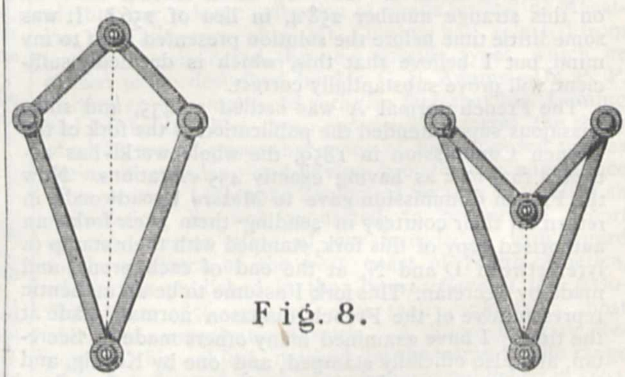


Fig. 8.

Let us now, instead of amalgamating the long links of the two linkages, amalgamate the short ones. We then get the linkage of Fig. 9; and if the pivot where the short links meet is fixed, and one of the other free pivots be

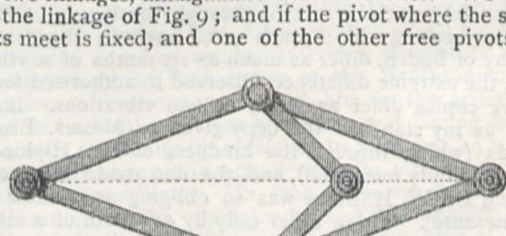


Fig. 9.

made to move in the circle of Fig. 6 by the extra link, the other will describe, not the straight line P M, but the straight line P′ M′. In this form, which is a very compact one, the motion has been applied in a beautiful manner

[1] Lecture at South Kensington in connection with the Loan Collection of Scientific Apparatus, by A. B. Kempe, B.A. Continued from p. 67.

to the air engines which are employed to ventilate the Houses of Parliament. The ease of working and absence of friction and noise is very remarkable. The engines were constructed and the Peaucellier apparatus adapted to them by Mr. Prim, the engineer to the Houses, by whose courtesy I have been enabled to see them, and I can assure you that they well worth a visit.

Another modification of the cell is shown in Fig. 10. If instead of employing a "kite" and "spear-head" of

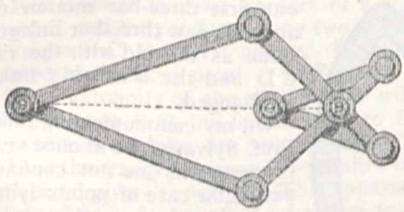


Fig. 10.

the same dimensions I take the same "kite" as before but use a "spear head" of half the size of the former one, the angles being, however, kept the same, the product of the heights of the two figures will be half what it was before, but still constant. Now instead of superimposing the links of one figure on the other, it will be seen that in Fig. 10 I fasten the shorter links of each figure together end to end. Then as in the former cases, if I fix the pivot at the point where the links are fixed together, I get

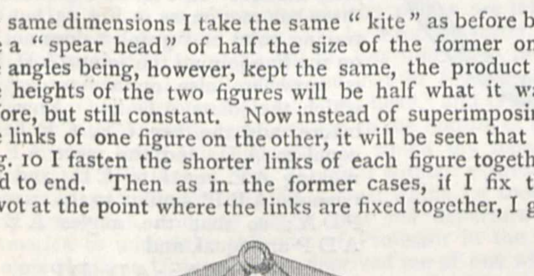


Fig. 11.

a cell which may be used by the employment of an extra link, to describe a straight line. A model employing this form of cell is exhibited in the Loan Collection by the Conservatoire des Arts et Métiers of Paris, and is of exquisite workmanship; the pencil seems to swim along the straight line.

M. Peaucellier's discovery was introduced into England by Prof. Sylvester in a lecture he delivered at the Royal Institution in January, 1874, which excited very great in-

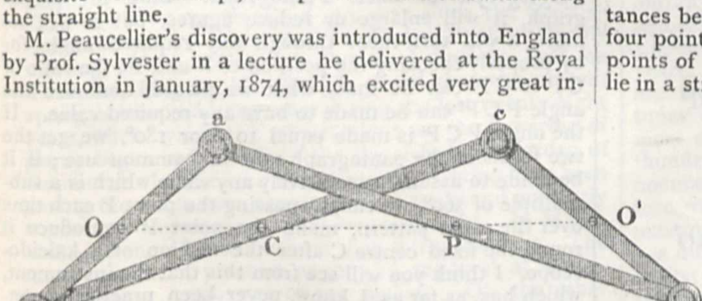


Fig. 12.

terest and was the commencement of the consideration of the subject of linkages in this country.

In August of the same year Mr. Hart, of Woolwich Academy, read a paper at the British Association meeting, in which he showed that M. Peaucellier's cell could be replaced by an apparatus containing only four links instead of six. The new linkage is arrived at thus.

If to the ordinary Peaucellier cell I add two fresh links of the same length as the long ones I get the double, or rather quadruple cell, for it may be used in four different ways, shown in Fig. 11. Now Mr. Hart found that if he took an ordinary parallelogramatic linkwork in which the

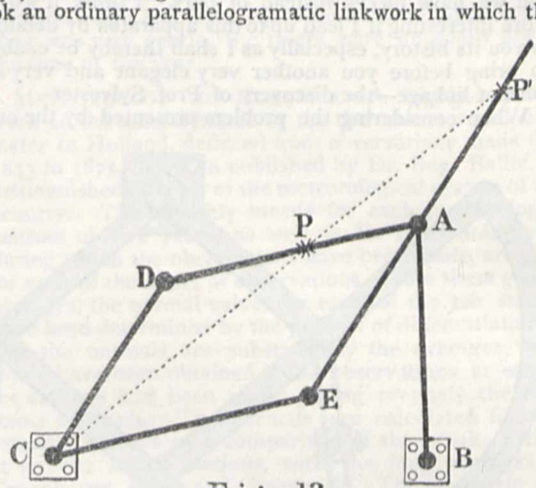


Fig. 13.

adjacent sides are unequal, and crossed the links so as to form what is called a contra-parallelogram, Fig. 12, and then took four points on the four links dividing the dis-

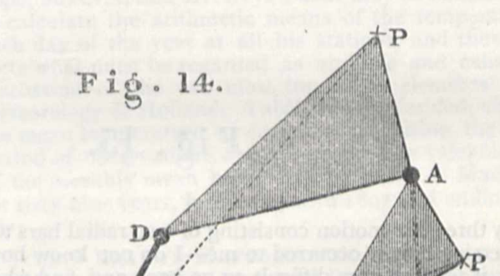


Fig. 14.

tances between the pivots in the same proportion, those four points had exactly the same properties as the four points of the double cell. That the four points always lie in a straight line is seen thus: considering the triangle $a\,b\,d$, since $a\,\mathrm{O} : \mathrm{O}\,b :: a\,\mathrm{P} : \mathrm{P}\,d$ therefore O P is parallel to $b\,d$ and the perpendicular distance between the parallels is to the height of the triangle $a\,b\,d$ as $\mathrm{O}\,b$ is to $a\,b$; the same reasoning applies to the straight line CO′, and since $a\,b : \mathrm{O}\,b :: c\,d : \mathrm{O}'d$ and the heights of the triangles $a\,b\,d$, $c\,b\,d$, are clearly the same, therefore the distances of O P and O′ C from $b\,d$ are the same, and O C P O′ lie in the same straight line.

That the product $\mathrm{OC} \cdot \mathrm{OP}$ is constant appears at once when it is seen that $\mathrm{O}\,b\,\mathrm{C}$ is half a "spear head" and $\mathrm{O}\,a\,\mathrm{P}$ half a "kite;" similarly it may be shown that $\mathrm{O'P} \cdot \mathrm{O'C}$ is constant, as also $\mathrm{OC} \cdot \mathrm{CO'}$ and $\mathrm{OP} \cdot \mathrm{PO'}$. Employing then the Hart's cell as we employed Peaucellier's, we get a five-link straight line motion. A model of this is exhibited in the Loan Collection by M. Breguet.

I now wish to call your attention to an extension of Mr. Hart's apparatus, which was discovered simultaneously by Prof. Sylvester and myself. In Mr. Hart's apparatus we were only concerned with bars and points on those bars, but in the apparatus I wish to bring before you we have pieces instead of bars. I think it will be more interesting if I lead up to this apparatus by detailing to you its history, especially as I shall thereby be enabled to bring before you another very elegant and very important linkage—the discovery of Prof. Sylvester.

When considering the problem presented by the ordinary three-*bar* motion consisting of two radial bars and a traversing bar, it occurred to me—I do not know how or why, it is often very difficult to go back and find whence one's ideas originate—to consider the relation between the curves described by the points on the traversing bar in any given three-bar motion, and those described by the points on a similar three-bar motion, but in which the traversing bar and one of the radial bars had been made to change places. The proposition was no sooner stated than the solution became obvious; the curves were precisely similar. In Fig. 13 let C D and B A be the two radial bars turning about the fixed centres C and B, and let D A be the traversing bar, and let P be any point on it describing a curve depending on the lengths of A B, B C, C D, and D A. Now add to the three-bar motion the bars C E and E A P′, C E being equal to D A, and E A equal to C D. C D A E is then a parallelogram, and if an imaginary line C P P′ be drawn, cutting E A produced in P′ it will at once be seen that P′ is a fixed point on E A produced, and C P′ bears always a fixed proportion to C P, viz., C D : C E. Thus the curve described by P′ is precisely the same as that described by P, only it is larger in the proportion C E : C D. Thus if we take away the bars C D and D A, we shall get a three-bar linkwork, describing precisely the same curves, only of different magnitude, as our first three-bar motion described, and this new three-bar linkwork is the same as the old with the radial link C D and the traversing link D A interchanged.

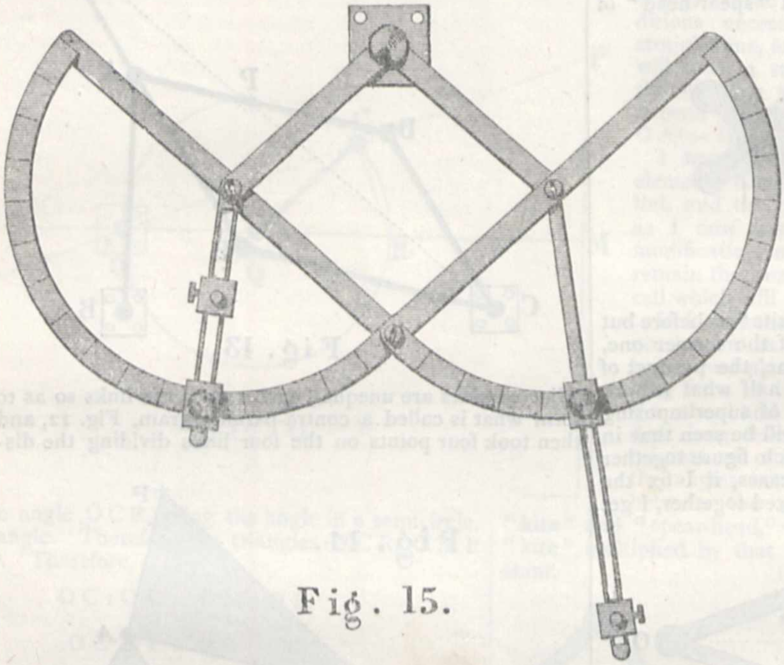


Fig. 15.

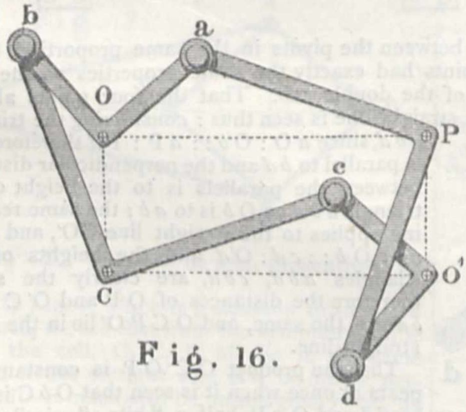


Fig. 16.

On my communicating this result to Prof. Sylvester, he at once saw that the property was one not confined to the particular case of points lying on the traversing bar, in fact to three-*bar* motion, but was possessed by three-*piece* motion. In Fig. 14 C D A B is a three-bar motion, as in Fig. 13, but the tracing point or "graph" does not lie on the line joining the joints A D, but is anywhere else on a "piece" on which the joints A D lie. Now, as before, add the bar C E, C E being equal to A D, and the piece A E P′, making A E equal to C D, and the triangle A E P′ similar to the triangle P D A; so that the angles A E P′, A D P are equal, and

P′E : E A : : A D : D P.

It follows easily from this—you can work it out for yourselves without difficulty—that the ratio P′ C : P C is constant and the angle P C P′ is constant; thus the paths of P and P′, or the "grams" described by the "graphs," P and P′ are similar, only they are of different sizes, and one is turned through an angle with respect to the other.

Now you will observe that the two proofs I have given are quite independent of the bar A B, which only affects the particular curve described by P and P′. If we get rid of A B, in both cases we shall get in the first figure the ordinary pantagraph, and in the second a beautiful extension of it called by Prof. Sylvester, its inventor, the *Plagiograph* or *Skew Pantagraph*. Like the pantagraph, it will enlarge or reduce figures, but it will do more, it will turn them through any required angle, for by properly choosing the position of P and P′, the ratio of C P to C P′ can be made what we please, and also the angle P C P′ can be made to have any required value. If the angle P C P′ is made equal to 0 or 180°, we get the two forms of the pantagraph now in common use; if it be made to assume successively any value which is a submultiple of 360°, we can, by passing the point P each time over the same pattern, make the point P′ reproduce it round the fixed centre C after the fashion of a kaleidoscope. I think you will see from this that the instrument, which has, as far as I know, never been practically constructed, deserves to be put into the hands of the designer. I give here a picture of a little model of a possible form for the instrument furnished by me to the Loan Collection by request of Prof. Sylvester.

After this discovery of Prof. Sylvester it occurred to him and to me simultaneously—our letters announcing our discovery to each other crossing in the post—that the principle of the plagiograph might be extended to Mr. Hart's contra-parallelogram; and this discovery I shall now proceed to explain to you. I shall, however, be more easily able to do so by approaching it in a different manner to that in which I did when I discovered it.

If we take the contra-parallelogram of Mr. Hart and bend the links at the four points which lie on the same straight line, or *foci*, as they are sometimes termed, through the same angle, the four points, instead of lying in the same straight line, will lie at the four angular points of a parallelogram of constant angles—two the angle that the bars are bent through, and the other two their supplements—and of constant area, so that the product of two adjacent sides is constant.

In Fig. 16 the lettering is preserved as in Fig. 12, so that the way in which the apparatus is formed may be at once seen. The holes are taken in the middle of the links and the bending is through a right angle. The four holes O P O′ C lie at the four corners of a right-angled parallelogram, and the product of any two adjacent sides, as for example O C · O P, is constant. It follows that if O be pivoted to the fixed point O in Fig. 16, and C be pivoted to the extremity of the extra link, P will describe a straight line, not P M, but one inclined to P M at an angle the same as the bars, are bent through, *i.e.*, a right angle. Thus the straight line will be parallel to the line joining the fixed pivots O and Q. This apparatus, which for simplicity I have described as formed of four straight links which are afterwards bent, is of course strictly speaking, formed of four plane links, such as those employed in Fig. 1, on which the various points are taken. This explains the name given to it by Prof. Sylvester, the "Quadruplane." Its properties are not difficult to investigate, and when I point out to you that in Fig. 16 as in Fig. 12, O *b*, *b* C form half a "spear-head," and O *a*, *a* P half a "kite," you will very soon get to the bottom of it.

I cannot leave this apparatus in which my name is associated with that of Prof. Sylvester without expressing my deep gratitude for the kind interest which he took in my researches, and my regret that his departure for America to undertake the post of Professor in the new Johns Hopkins University has deprived me of one whose valuable suggestions and encouragement helped me much in my investigations.

(*To be continued.*)

METEOROLOGICAL NOTES

NOTES OF THE WEATHER IN SCOTLAND, FARÖ, AND ICELAND.—It appears from the meteorological returns for the eight principal towns in Scotland, that the weather of last April has been distinguished by low temperature, 3°·7 under the average, great fluctuations in the barometric pressure, large rainfall distributed among the towns with unusual uniformity, much wind and that more persistently from the eastward than has been before chronicled for any month of any year since the Scottish Meteorological Society was founded. At the monthly meeting of the Edinburgh Botanical Society, held on Thursday, May 10, Mr. McNab stated that the present spring is later than any other during the last twenty-eight years, when systematic observations on the flowering of plants began to be made in the Royal Botanic Garden of Edinburgh. In Farö the winter and early spring have been among the worst ever known, high easterly and northerly winds and snowstorms being very prevalent. In March and April snow fell on no fewer than thirty-one days. The mean barometric pressure at 32° and sea-level at Thorshavn during April, was 29,945 inches. On the other hand the winter, until Easter, was one of the finest ever known in Iceland, particularly in the north of the island. There was little snow, any frost that occurred was of short continuance, and fine calm weather prevailed. But about Easter-day a series of northerly snowstorms began, accompanied by severe frosts, which lasted with little intermission for about a week, causing the loss of many ships, and snowing up the pastures. Since these storms sunshine prevailed up to May 6. When the steamer left Reykjavik the Greenland and Spitzbergen ice had appeared off the northern coasts about the middle of March, but only stray icebergs neared the land, the ice becoming "land-fast" nowhere in any quantity. The season has also been singularly mild in Canada. Spring set in there fully three weeks earlier than usual, and as very little rain had fallen up to the close of April and the thaw was very gentle, the rivers were unusually low for the time of the year.

METEOROLOGY OF HOLLAND.—A highly-important work on the annual march of the thermometer and barometer in Holland, deduced from observations made from 1843 to 1875, has been published by Dr. Buys Ballot, the distinguished director of the meteorological system of that country. The monthly means for each meteorological lustrum of five years, as well as for the whole period during which the observations have been made, are given for each of the hours of observations. From these general averages, the normal values for each of the ten stations have been determined by the process of differentiation, so that the normals are substantially the averages which would have been obtained if the observations at each of the stations had been made during precisely the same terms of years. The normals are calculated for very extended periods by a comparison of the results arrived at for the Dutch stations, with the long averages for Copenhagen, Paris, and Greenwich. Thermometric and barometric normals have also been determined for each day of the year for all the stations, which cannot but prove to be of considerable value in framing forecasts of the weather and in some other practical matters. We hope, however, that Dr. Buys Ballot may be enabled soon to calculate the arithmetic means of the temperature of each day of the year at all his stations, and thus complete what must be regarded as an able and exhaustive discussion of the two most important elements of the meteorology of Holland. Tables are also added, showing the mean temperature of each month during the whole period of observations, and an exceedingly valuable table of the monthly mean barometric measure at Maestricht for sixty-nine years, beginning with 1807 and ending with 1875.

TYCHO BRAHE'S METEOROLOGICAL JOURNAL.—The Royal Academy of Sciences and Letters of Copenhagen has laid scientific men generally under a debt of gratitude in publishing *in extenso*, the Meteorological Journal, kept at Uraniborg in the Isle of Hveen by Tycho Brahe from 1582 to 1597. To the journal is appended a clear and interesting *résumé* of the observations by M. Paul la Cour. The results of the observations made on clouds, rain, snow, hail, fog, winds, frost, thunder, halos, and auroras, by the celebrated astronomer nearly 300 years ago, are compared with similar observations made at Copenhagen and other stations in Denmark in recent years. The results of the different sets of observations are fairly accordant when the different positions and times of observing are taken into consideration. The most noteworthy difference is in the monthly curve of thunder, the maximum at Hveen being strongly pronounced in June, whereas the recent observations at fourteen stations in different parts of Denmark have the maximum extending equally over June, July, and August —a difference perhaps due to a different seasonal distribution of thunder in different parts of Denmark. Of the seventy-eight auroras which were noted by Tycho Brahe, seventy-six occurred during the ten years from 1582-1591, and only two during the six years immediately following. From the detailed descriptions given of certain auroras and auroral arches, M. Paul la Cour concludes that the magnetic inclination at this observatory during 1584 was somewhere between 72° 25′, and 73° 25′.

"ATLAS MÉTÉOROLOGIQUE" OF THE OBSERVATOY OF PARIS, 1875.—A rapid glance through the *Atlas Météoro-*

logique for 1875 is enough to show that it more than sustains the high character of the publications of previous years. The thunderstorms and hailstorms of France for 1875 are elaborately and ably discussed, and to these discussions are appended no fewer than twenty-six memoirs on different meteorological subjects, by such well-known meteorologists as the two Becquerels, R. P. Denza, Brault, Crova, Moritz, Belgrande, Lemoine, Raulin, Coumbary, Brito-Capello, and Fron. Several of the more important of these memoirs not yet noticed by us, we shall bring before our readers on an early occasion, particularly those dealing with the climatology of Asia Minor and of Portugal, and with the rainfall of Algiers.

WEATHER MAPS IN AUSTRALIA.—Mr. Russell, of the Sydney Observatory, began a few months ago to issue daily weather maps for Australia. The plan of preparing the maps, which possesses some novel features, is briefly this :—There is a block of type metal with an electro of the coast-line and mountains fixed on it, and at the position of each station there is a slot in the metal block for the placing of the wind and weather symbols and figures which show the force of the wind, height of the barometer, and the temperature. The sea symbols, arrows, curves, words descriptive of the state of the weather, and in short everything which may be required on the map as varying from day to day, are glued on to the face of the metal block and held so fast that printing from an ordinary letter-press may be begun at once. The whole map is prepared in about two hours, and after a few copies are printed off for the use of the observatory, the block is sent to the *Herald* newspaper and by them stereotyped with their other matter. Copies of several weeks' weather maps, thus prepared and printed, have been forwarded to us. A note in manuscript on the map is sent to the *Herald* every day giving remarks on the weather of that day, and forecasts of coming weather. A system of exchange has been already effected with Melbourne, will soon be completed with Adelaide, and it is expected that all the other colonies will join in the effort to make the system as complete as possible so as to secure for this region of the globe effective warnings of coming storms. The colonial governments will no doubt see that this system of weather telegraphy, so admirable in itself and calculated to be highly beneficial to large public interests, will be furnished with the funds necessary for its efficient maintenance and further development.

STONEYHURST METEOROLOGICAL AND MAGNETICAL OBSERVATIONS, 1876.—This publication maintains the high character of its predecessors for the care and exhaustiveness with which the results are worked out and detailed in each of the monthly reports, and its value is further enhanced by the notes and tables of agricultural and horticultural results which have now been introduced. We are glad to see that observations of cirrus clouds are sent monthly to Dr. Hildebrandsson, of the Upsal Observatory; and we hope that, from the great importance of these observations in questions affecting atmospheric circulation, Father Perry will be enabled to add them to his future monthly reports. It was pointed out by us last year that in discussing the hours of occurrence of the minimum temperatures, the double inflexion in the curve which was obtained was solely due to the adoption in the discussion, of the civil day, beginning with 1 A.M., and that while the civil day must be employed in discussing the maximum temperatures, the astronomical day must be employed for the minimum temperatures. The minimum temperatures have now been discussed afresh, the astronomical day being adopted, with the result that there is only one inflexion in the time curve of the minimum temperature, the hour of lowest daily temperature falling in the annual curve between 4 and 5 A.M.

CLIMATE AND INFANT MORTALITY IN TASMANIA.—A carefully prepared paper on this subject, by Mr. E. C. Nowell, Government Statistician, has been published in the *Report of the Royal Society of Tasmania for* 1875, in which the statistics for Tasmania are compared with those for South Australia, Victoria, Queensland, and New South Wales for the five years 1869-73. Among the interesting results arrived at, the most important are these two, viz., first, the average number of deaths of infants under one year to 100 births for each colony was—South Australia 14·24, Victoria 11·86, Queensland 11·07, New South Wales 9·57, and Tasmania 9·45; and secondly, the proportions which the deaths of children under five years of age bore to 100 deaths at all ages were—South Australia 54·17, Queensland 46·33, Victoria 45·50, New South Wales 42·14, and Tasmania 28·08. These interesting and instructive results, showing the advantages possessed by Tasmania in regard to the low rate of mortality among infants and children, Mr. Nowell considers to be chiefly due to the remarkable salubrity of its climate. It is highly probable that it is to the climate that this low infant mortality must be ascribed, seeing that the summer heat of Tasmania is not nearly so great as that of the other colonies, and consequently the mortality from bowel complaints may be expected to be much less, whilst in all these colonies the temperature does not fall so low in the winter months as to prove so seriously fatal to the very young, as is the case in such climates as that of Great Britain. Mr. Nowell would do a very valuable piece of work if he extended the inquiry he has so well begun, in the directions we have indicated, so as to ascertain the particular diseases, the mortality from which is unusually low in Tasmania, and the seasonal distribution of the deaths from different diseases.

ON THE PROPER LENGTH OF THE GYMNASIUM SWING

MANY of the evolutions performed upon the gymnasium swing can be made equally well upon swings of any length; with others it is different. When the evolution is such that the swing in one direction marks a period of exertion, while the return is comparatively a period of rest, then the evolution cannot be equally well performed with swings of all length.

One of the most useful exercises is made as follows :—Reaching up and grasping the rings let the swing be started, and at the beginning of a forward swing the feet are thrown above the head, the legs being flexed. As the forward swing closes the legs are extended and the arms flexed, the body being thus thrown upward and outward. Here, also, by some practice, one learns to accomplish the swing with a minimum of exertion, which a good gymnast always does; nevertheless, the number of swings before exhaustion takes place varies with the length of the ropes, as is shown in the following series of experiments made upon myself :—

Nipher.

l	t	n
12	4·5	10·0
11	4·3	12·2
10	4·1	12·8
9	4·0	15·4
8	3·9	15·2
7	3·8	13·0
6	3·7	10·6

l = distance from point of suspension to centre of hands; t = time of one complete oscillation (forward and back); n = No of oscillations before exhaustion.

It will be observed that n reaches a maximum where l = about 8·5 feet, or where the time of a full swing is between 3·9 and 4·0 seconds.

Another series of experiments was made upon Mr. Cunningham, a young man about 5 feet 2 inches in height, and of light build. The maximum value of n is here reached when the length of the rope was about ten feet, and here the time of a full swing was about 4·1 seconds.

My own height being about five feet eleven inches, it will be observed that these two cases are sufficiently representative.

Cunningham.

l	t	n
12	4·3	14·0
11	4·3	16·3
10	4·1	17·0
9	3·8	14·6
8	3·7	12·6

The swing was shortened by drawing the rings up from the ground, and in the latter table the values of n for short ropes are a little too small, as he seemed fearful of falling. Hence we may affirm that in order that this and similar evolutions may be elegantly performed, the time for the full swing should be four seconds.

The cause of rapid fatigue with long ropes is that the body must be held in a constrained position for too long a time. With very short swings the muscles are forced to work with too great a velocity.

The muscular action is here too complex to allow of any mechanical discussion, but the general results are exactly what the discussions of Prof. Haughton might have enabled us to predict. FRANCIS E. NIPHER

Washington University

NOTES

THE demise of such veterans in biology as Von Baer, Ehrenberg, &c., during the past year has left gaps in the lists of honorary fellows of our scientific societies which come to be filled up with men almost of a different generation, yet worthy successors of the great masters depatted. We understand the three subjoined *savans* have recently been elected foreign members of the Linnean Society—viz., Pierre Du Charte of Paris, highly distinguished for his researches in teratological, physiological, and other branches of botany; Prof. Carl Gegenbaur of Heidelberg, whose labours in zoology and the comparative anatomy of the vertebrates and invertebrates are acknowledged as of the highest standard; Prof. Rudolph Leuckardt of Leipzig, by whose philosophical investigations into the morphology and physiology of the lower forms of animals and establishment of the group coelenterata, zoologists of all countries are highly indebted.

WE are glad to hear that Dr. Dohrn's Zoological Station continues to make satisfactory progress. The number of naturalists who have availed themselves of the institution, we are informed, has reached eighty, from almost all parts of Europe. The summer dredging with the small steamer will now shortly commence, and we may hope that besides the important physiological work which is there done, that a complete knowledge of the rich fauna of this bay will be a further result furnished by this station. The institution is carried on under the direction of Dr. Dohrn, the detail management being in the hands of Dr. H. Eisig, who is backed up by two assistants. The aquarium belonging to the station has in their hands for some time been the most successful in Europe, and naturalists we do not doubt will find the experience gained by some years working enables their wants to be more readily provided for. A statement has appeared in an English paper which might lead one to think some change had been made, but we are in a position to state that no alteration has been made, and that with increased opportunity of collecting material the institution will become each year more useful.

ALTHOUGH M. Leverrier's health is so unsatisfactory he continues to attend to his professional duties as persistently as ever. The number of stations oraganised by him in connection with the international service now exceeds 1,200. He is preparing instructions to be sent to each correspondent on the method of better utilising warnings from the Observatory. He confesses that the agricultural service is in a period of uncertainty, and that some time must elapse before it can render much service to the commonwealth. He urges strong reasons why the service—not conducted by military men, as in America—should be conducted by men accustomed to military discipline.

THE primary clock of the Paris Observatory is now regulating the motion of the clocks of the Conservatoire, St. Sulpice, and the Luxembourg. M. Leverrier proposes to adapt the same system to a number of other public clocks, and even to those which are used in the cab stations. But the application of the system is delayed for want of funds.

PROF. RUPERT JONES, F.R.S., is preparing a new edition of Dixon's valuable "Geology of Sussex" for Mr. W. J. Smith, of Brighton. The work will be brought up to the present state of knowledge. The descriptions and lists of Sussex fossils will be carefully revised in this new edition, and a full account will be given of the Sub-wealden boring and its results, of the Warren-Farm Well, and of the archæological discoveries at Cissbury and elsewhere in Sussex. It is also arranged that a selection of the original quarto plates of Mantell's "Fossils of the South Downs; or, Illustrations of the Geology of Sussex" (1822), with descriptions according to our latest knowledge of the subjects, shall form part of the new volume.

A NEW application of the principle of the magic-lantern has been lately introduced into London for drawing attention after dark to the names of restaurants and shops. At present it is only used where the establishment has a lamp overhanging the pavement. The lenses are fitted into the bottom of the lamp, the words to be read are painted on the "slide," which has an opaque ground, and thus the advertisement is thrown in letters of light on to the pavement. Ordinary gas lamps are used, and when the apparatus is once fixed the announcement appears every time the lamp is lighted without any further trouble.

THE anniversary meeting of the Geographical Society was held on Monday, and as usual, a large increase of numbers was reported, as well as the prosperity of the Society generally. The president, Sir Rutherford Alcock, reviewed the progress of geographical science during the year, a year remarkable by the return of three important expeditions to England—the *Challenger*, the Arctic, and that under Lieut. Cameron. The medals, the award of which we have already announced, were presented to Sir George Nares, the Pundit Nain Singh, and Capt. Markham. The president, in concluding his address, announced that the Society's African Exploration Fund Committee were about to appeal to the Society and the public for support and co-operation in the prosecution of continuous and systematic African exploration. In view of the interests concerned in this work, the Council felt confident that their appeal would meet with a ready response, not only in the United Kingdom, but in all our colonies.

ON the evening of June 5 the first trial, in this country, of the Jablochkoff electrical light will be made at the West India Docks. The object of this trial is to test the applicability of this new light to purposes of lighting up of docks, warehouses, &c., in order that work may be continued during the night.

"SUMMER Schools" are becoming a regular institution in America, and no more pleasant way could be devised of combining the *dulce* and the *utile* than that of a proposed aquatic summer school of natural history, which, under the direction of Prof. Theodore B. Comstock, of Cornell University, expects to charter a large steamer, and spend the summer around the shores of Lake Superior in the study of the geology and natural history of that region. The steamer will accommodate from seventy-five to one hundred passengers, to be made up of students and professors. Regular instruction will be given in the form of lectures during the voyage, and every facility afforded by the examination of mining localities and the like. The vessel will probably start from Cleveland or Detroit on July 7, and proceed thence to Lake Superior, making its full circumnavigation. The coast of Georgian Bay, on Lake Huron, will be investigated on the return voyage. The expense will probably amount to about 125 dollars for each person. In addition to the aquatic summer school mentioned above, Harvard University announces two special summer courses of instruction, one in zoology and the other in geology.

THE progress of industry in France (denoting by industry the working of raw material) has been very rapid, much more rapid, proportionally, than that of agriculture. We learn from *La Nature*, that in half a century, the employment of cast iron, so necessary to industry, has been multiplied tenfold, and that of coal twenty-fold. The total power of steam-engines has increased in still greater proportion; it is at least thirty times greater than it was in 1840. Going further back, the proportion would be less interesting, as steam was used in but few establishments. In 1820 there were only sixty-five steam-engines in the whole of France. As an acquisition of material force these engines represent in value at least 25 million workmen, added to the 10 million who labour in workshops, and to the motor forces furnished by nature gratuitously, air and water. There are in France nearly 40,000 weirs, the falls from which work more than 80,000 mills of every kind, and this number might be doubled. In some parts, lastly, they are beginning to utilise the force of the tide.

AT a recent meeting of the French Physical Society M. Gouy gave an account of experiments he had made on flames produced by a mixture of air and coal-gas, holding in suspension pulverised metallic salts. The salts, dissolved in water, were introduced by a pulveriser, acting with air compressed to half an atmosphere. In these flames the blue surface of the interior cone, which gives the spectrum of carbon, gives also the lines proper to the salt which the flame contains. These lines are not visible beyond this part, and they coincide with the principal lines of the metal in the electric spark. The metals sodium, strontium, magnesium, lithium, manganese, iron, cobalt, bismuth, cadmium, zinc, and osmium give this phenomenon distinctly. Platinum gives a special spectrum formed of regular bands. These experiments seem to prove that there is at the base of the flame a very fine layer which has a temperature much higher than the flame properly so-called.

THE exploration of the Angara, proposed by the Russian Geographical Society, has taken a yet larger extension. M. Sibiryakoff, who has presented a gift of 2,000 roubles, proposes to undertake also the exploration of the water-parting between the Obi and Jenissei, to solve the question of the practicability of a canal between the two rivers. Owing to the great commercial importance of such a canal, the Geographical Society has agreed to the proposal of M. Sibiryakoff, and will send an expedition for that purpose.

NEAR Lake Ourmia (N.W. Persia), a hill near Digala is irregularly excavated by a number of galleries for its nitrous earth, strongly impregnated with saltpetre. This loose, friable soil, of brownish colour, in irregular horizontal beds, includes layers of a mostly amber-brown earth, with layers of bone-ash, intermixed with large and small fragments of human bones, charred remains of straw, and thin seams of carbonised seeds of cereals. Fragments of burnt earthenware are scattered through this bed, and through the whole of the hill. Nearly in the middle of the hill is a conical hollow, cylindrical above, and becoming narrower upwards, like the inside of a high furnace. The inner wall shows four or five ranges of repositories, several feet distant from each other, and made of slabs of eocene sandstone, about $1\frac{1}{2}$ ft. broad. These slabs of a rust-brown colour, bear evident traces of having been exposed to a fierce fire; and the whole chamber may thus be inferred to have served for a furnace to burn dead bodies. This view is confirmed by the traditions still extant among the surrounding people. Fragments of large pot-like vases, and of coffins made of slabs of sandstone, both inclosing an earthy residuum, mixed with fragments of skulls and bones show that in the same place, burials have been effected without cremation. The abundance of saltpetre in the soil of the hill has probably been derived from the nitrogen set free by the decomposition of organic remains.

THE *Phormium tenax* or New Zealand Flax, is, it is said, being largely planted in St. Helena, on behalf of a fibre company, who propose so to plant all the Government waste lands in the island.

WE have received from Dr. Petermann a very useful map issued in connection with the Russo-Turkish war. Its purpose is to show at a glance the relative position of the boundaries of Russia, Turkey, Persia, and British India. It extends from Bosnia to Central Asia, and from the north of the Black and Caspian Seas to the Indian Ocean, and includes enlarged special maps of the Nile Delta and of Crete.

THE first field-day of the Liverpool Geological Society was held on Saturday last. The members and their friends proceeded to Crosby by rail and from thence by 'bus through Little Crosby, Hightown, Altcar, Downholland, Has Rayne, to Hallsall, and back again through Lydiate and Maghull to Sefton, where they had tea and examined the church. The object of the visit was to examine the great post-glacial deposits of the West Coast of Lancashire. The party was guided by Mr. T. Mellard Reade, C.E., F.G.S., who described the succession of the beds and their superficial extension. He explained that what they had seen was only a part of a very extensive series of deposits surrounding our coasts and found at most estuaries. The society last May examined a portion of the same series disclosed by the North Dock excavations, and the present excursion would enable them to better understand this most interesting part of the geology of Lancashire. At the Alt Mouth was found a peat and forest bed between high and low water-mark washed daily by the tide. The moss land between the inland edge of the 25-feet plain was only an extension of this submarine forest which passes under the sand hills and joins the moss. Under the moss lies the main silts with here and there some freshwater deposits on the surface.

SOME interesting disclosures were made last week at the Marlborough Street Police Court as to the method on which certain war maps are constructed. A certain publisher, whose name is probably unfamiliar to most of our readers, has published one of those exaggerated pictorial maps of the seat of war so attractive to the indiscriminating public. We have seen the map, and a very misleading and rude specimen of cartography it is. Its natural defects are bad enough, but it came out during the proceedings that intentional errors—names of non-existing places and wrong positions of existing places, were introduced for the purpose of detecting imitations. The magistrate, Mr. Newton, was therefore to a considerable extent justified in stating that the designer of the map seemed to have constructed it out of his own brain, and he virtually dismissed the summons.

FROM the report read at the annual meeting of the Nottingham Literary and Philosophical Society, we see that it now has 352 membeis of various classes. The Society has had several scientific lectures during the session, and we are specially glad to see that the Natural Science Section is in a flourishing condition, having had twenty-nine meetings and excursions during the session, at which papers were read on various subjects of scientific interest.

THE Société Française de Navigation Aërienne, an institution which has been approved by the Minister for Public Instruction, is to organise a collective exhibition at the Champ de Mars. It will include any means of propelling and governing in the air. Any instrument which has proved efficacious in some degree will be admitted if its dimensions are not too large, or by model, if otherwise. Any apparatus for making aërial observations, or helping aëronauts in any way will be admitted. The collection will also include maps, books, manuscripts, and newspapers relating to aërial navigation.

WE have received from Dr. Warren de la Rue a small pamphlet containing two sets of tables which must prove of great use to most scientific workers. There are tables for the reduction to 0° centigrade of a mercury column observed with a glass scale divided into millimetres, and tables for the reduction of millimetres (mercurial pressure) to thousandths and millionths of an atmosphere, and *vice versâ*. These tables are printed for private circulation.

AN important Russian work has just been published by Prof. Inostrantsef—"Geological Sketch of the Povyenetz District, Government Olonetz, and of its Mines." This large volume (750 pp.), being the result of seven years' explorations, contains detailed reports on the travels of the author, an orographical description of the district (the surface of which exceeds that of Switzerland), an interesting chapter on the metamorphism of the green slates, and a sketch of the glacial formations. It is accompanied by maps, engravings, and chromolithographed plates representing microscopical cuttings of rocks.

THE additions to the Zoological Society's Gardens during the past week include an African Turkey Buzzard (*Buteo tachardus*) from Africa, presented by Mr. A. Anderson, F.Z.S.; two Rendall's Guinea Fowls (*Numida rendalli*) from Bogos Country, Abyssinia, presented by Capt. Burke, s.s. *Arcot;* three Carpet Snakes (*Morelia variegata*) from Australia, presented by Mr. J. Moseley; a Guianan Crested Eagle (*Morphnus guianensis*) from the Upper Amazons, a Green-necked Pea-fowl (*Pavo spicifer*) from Java, two Barred-tailed Pheasants (*Phasianus reevesi*) from North China, a One-wattled Cassowary (*Casuarius uniappendiculatus*) from New Guinea, a Great-headed Maleo (*Megacephalon maleo*) from the Celebes, purchased; an Inconvenient Curassow (*Crax incommoda*) from South America, deposited; a Derbian Wallaby (*Halmaturus derbianus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN

COMETS OBSERVED BY HEVELIUS.—Of the eight comets observed by Hevel, better known as Hevelius, at Dantzic, with such degree of precision as could be attained with his instruments, the observations of two only have been reduced with the aid of modern places for comparison stars, &c., and in these two cases only have we other orbits than those calculated by Halley, which appear in his *Synopsis Astronomiæ Cometicæ*. The observations of the comet of 1664 have been discussed by Herr Lindelof, with the view of ascertaining whether any support were afforded by them, to a conjecture of identity of the comet, with the first comet of 1853; and those of the comet of 1683, were similarly reduced by Mr. W. E. Plummer, in his examination of the elliptical tendency of the orbit indicated by the computations of Prof. Clausen, who had previously recalculated a few of the observations. There remain the comets of 1652, 1661, 1665, 1672, 1677, and 1682; Mechain's reduction of the observations of the second of these bodies nearly a century since, will hardly be considered final.

The observations of the comets of 1672 and 1677 were published in the second volume of the *Machina Cœlestis*, and in small special treatises. This second volume of the great work of Hevelius, as is well known, is extremely scarce, the whole of the impression, with the exception of such copies as had been already presented to astronomers having been lost in the fire which destroyed the observatory, library and papers of Hevelius on September 26, 1679. The copies thus saved were so few in number, that as Lalande remarks "On peut regarder cet ouvrage comme un manuscrit;" and the special treatises to which we have alluded are perhaps of equal difficulty of access. The observations of the comets of 1652 and 1661 were printed in the *Cometographia*, not a work of very great rarity, as well as in the scarce volume of the *Machina Cœlestis;* those of the comet of 1665 also appear in this volume, in a special treatise, and in the *Prodromus Cometicus*, while those of the comet of 1682 (Halley's comet) are found in *Annus Climactericus*, and have been fully utilised.

A new reduction and discussion of the observations of the comets of 1652, 1661, 1665, 1672, and 1677, is certainly a desideratum, and important assistance in this direction might be afforded by a republication of the original observations of Hevelius from some quarter where the scarce volume is accessible. Mädler remarks upon a certain degree of resemblance between the elements of the comet of 1672 and those of the comet of 1812, which is shortly expected to return to perihelion; and it has been pointed out in this column that Halley has given the descending in place of the ascending node, for a comet observed in 1686—an oversight which has found its way into all catalogues of cometary orbits hitherto published, so that a re-computation of the orbits of the five comets we have mentioned, which now rest upon the figures of the *Synopsis Astronomiæ Cometicæ* is wanted, if only for verification.

"THE OBSERVATORY."—The second number of this new periodical is before us. Mr. David Gill continues his paper on "The Determination of the Solar Parallax;" we have the first part of an article giving the substance of a lecture recently delivered at Gresham College, by the Rev. E. Ledger, on "The Scintillation or Twinkling of the Stars," which has long been an obscure subject; Mr. Marth continues his Ephemerides for aiding physical observations of the Moon, Mars, and Jupiter; and there is also a report of the proceedings at the last meeting of the Royal Astronomical Society, including the discussion on the papers read, which, as was mentioned in a previous notice, it is intended should form a feature of the publication. We think every one who is competent to judge of the actual state of the case will agree in the opinion expressed at p. 55, while remarking on Mr. Todd's extension of Damoiseau's Tables of Jupiter's Satellites to the end of the present century, that "the time has hardly yet come for the formation of entirely new Tables." So far as regards the necessary observations, it must be admitted that they are being followed up with vigour at several observatories. The first binary star orbit on p. 58, refers to ξ Scorpii (ξ Libræ of Flamsteed), not to ζ Libræ; the error, however, is made in the *Astron. Nachrichten*, whence the orbit is taken.

L'ÉTÉ DE LA SAINT-MARTIN ET LES ÉTOILES FILANTES.—In No. 493 of the *Bulletin Hebdomadaire* of the French Scientific

Association, the Abbé Lamey, under the above heading, endeavours to explain by a new theory, certain abnormal temperatures which in one case, at least, has formed the subject of popular tradition. "The Summer of St. Martin," as the common phrase runs, presented itself, according to the Abbé, in a very definite manner in the last year; the month of November commenced colder than usual, but on the 12th it suddenly became warmer than from the sun's altitude could have been expected. Long-continued notice of a similar rise in temperature about the feast of St. Martin the Abbé considers is a proof that our ancestors were excellent observers, while the existence of a tradition upon the point shows clearly that the phenomenon has not been confined within restricted limits; it has been exhibited, he says, simultaneously in Europe and in the United States, and this without being materially affected by the climacteric conditions of the places of observation. One circumstance only he thinks appears to influence it, viz., the latitude; it vanishes as the equator is approached, and is not yet known to be recognised in the southern hemisphere.

The anomalous thermometric effect is not, however, perceptible only about St. Martin's Day. There is an analogous phenomenon according to the Abbé, in August: "une chaleur torride qui règne subitement après quelques jours de refraîchissement de l'air," and a similar effect, though in an opposite direction, has been noticed at the end of April or at the beginning of May, when vernal frosts so disastrous at this season occur, and have often been preceded by "une douce chaleur précoce," as the Abbé terms it, which has hastened forward the vegetation.

After remarking that the cause of such abnormal changes of temperature is not to be sought in any influence residing either in the sun or in the earth's atmosphere, it is suggested by the Abbé that it may be more probably found in what he calls cosmical meteorology, or as we are more accustomed to term this branch of science, meteoric astronomy. In November, August, and April meteors are more numerous than usual, and two of the greatest periodical showers yet observed, fall in November and August. His theory is that when a large number of meteors are passing between the earth and the sun, the solar rays are intercepted to a sufficient extent, to cause a diminution of temperature on the earth's surface, while, when a similar large number of meteors are so placed that they might reflect the heat derived from these rays, and so produce an effect of the opposite nature, that, to use his own words, those calorific rays "qui viendront frapper l'essaim météorique encore voisin de la terre seront *réverbérés* sur notre planète, de façon à recevoir alors un surcroît de chaleur." The Abbé lays some stress also upon another point of apparent coincidence: the intensity of the periodical meteoric showers of November varies from year to year, and "the summer of St. Martin" does not present itself under the same circumstances in every year.

In thus noticing the Abbé Lamey's attempt to explain a phenomenon which has been so long remarked as to have become a popular belief, at least in France, it will be understood that we are by no means advocating the probability of such a theory.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—In a Convocation held May 23 a decree was carried, without opposition, to the effect that the Vice-Chancellor and Proctors be authorised to nominate a delegate to represent the University at the 400th anniversary celebration of the University of Upsala, in September next.

In a Convocation to be held on June 5 it will be submitted to the House that the Curators of the University Chest be authorised to expend a sum not exceeding 7,000*l*. on the construction and fittings of new chemical laboratories at the University Museum. Also that a sum not exceeding 2,400*l*. be expended on certain additions to the University observatory.

An examination will be held in common at Magdalen, University, and New Colleges, on Tuesday, June 26, for election to the following mathematical scholarships:—One demyship at Magdalen College, of the annual value of 95*l*., inclusive of allowances; one scholarship at University College, of the annual value of 80*l*., tenable for five years during residence; one scholarship at New College, of the annual value of 100*l*., tenable for five years during residence. Testimonials of conduct, &c., to the President of Magdalen College, Mr. C. J. Faulkner, of University College, or the Sub-Warden of New College, between 4 and 6 or 8 and 9 P.M., June 25.

The commemoration fixed for June 13 will, it is understood, be held in the Sheldonian Theatre, although no official notice to that effect has appeared. There will be the usual round of festivities attendant on the event, though it has not transpired if the University will confer any honorary degrees on distinguished persons at the commemoration.

CAMBRIDGE.—The Museums and Lecture-rooms Syndicate, in their Eleventh Annual Report, just issued, state that the buildings are in an efficient state of repair, and the collections, to which many valuable additions have been made during the past year, are in good order. They draw attention to the munificence of the Chancellor of the University, the Duke of Devonshire, who has now completely furnished the Cavendish Laboratory with the instruments required by the present state of science. Profs. Liveing, Dewar, and Stuart complain of want of suitable accommodation for the work of their several departments, and the Syndicate concur in the reasonableness of their complaints.

An important report has been issued by the Musical Examinations Syndicate, which states that under existing regulations for obtaining a degree in music no provision is made for testing the literary and scientific qualifications of the candidates. They therefore recommend that no candidate be admitted to the examination for the degree of Mus. Bac. unless he have passed Parts I. and II. of the Previous Examinations, or one or other of their equivalent examinations. As to the examination for the degree of Mus. Bac., it is proposed to divide it into three parts—1, a preliminary examination, consisting of acoustics, harmony, counterpoint; 2, the exercise; 3, a more advanced examination in musical science; and that no person be accepted as a candidate for the second or third parts until he has qualified in the previous part or parts. In order to encourage the study of music, that it be recognised as the subject of an additional special examination for the ordinary B.A. degree, and that a student who has passed the Previous and the General Examinations, and is in his ninth term of residence at least, having previously kept eight terms, shall, on passing the preliminary examinations in acoustics, harmony, and counterpoint, be entitled, when he has kept nine terms, to receive the degree of Bachelor of Arts.

The "Rede" lecture was delivered on May 25 in the Senate House by Sir C. Wyville Thomson, who gave a brief sketch of the main results obtained by the *Challenger* expedition.

LONDON.—A new and additional Chair of Clinical Surgery has been created at King's College, which is to be filled by Prof. Lister of Edinburgh. The Chair of Systematic Surgery is thus still vacant.

EDINBURGH.—The students at the University have, during the past session, taken a step which it seems surprising they have not taken long ago. There is, in the Scotch universities, no college life as in England, the students appearing at their classes at the proper hours, and then dispersing to their respective lodgings in various parts of the town. While this system has undoubtedly its advantages, it is attended with not a few social, moral, and physical drawbacks, so that we are glad to learn that the Edinburgh students have started a Students' Club which has been thoroughly successful, and calculated we believe, if prudently conducted, to be productive of considerable benefit to the raw and lonely Scotch youth "when first he leaves his father's fields," to get what training and equipment for the future fight Edinburgh can give him.

By the transference of Prof. Lister to London, the Chair of Clinical Surgery in the University becomes vacant.

SIR JAMES KAY-SHUTTLEWORTH.—The death took place on Saturday last of Sir James Kay-Shuttleworth, a name well known in connection with educational and social reform. The deceased baronet, who was born at Rochdale on July 20, 1804, was for some time secretary to the Committee of Council on Education, and whilst fulfilling the duties of this post he was mainly instrumental in establishing a system of school inspection by officers appointed by the Government. On his resignation he was succeeded by Mr. Lingen, now permanent secretary of the Treasury, who was succeeded in his turn by Sir Francis R. Sandford. Under Sir James's scheme teachers were divided into nine grades, and received money grants, not according to the number of their scholars or of their passes, but largely, according to the grade they had obtained by examination or service. He was hostile to the Revised Code, which was introduced, about twelve years after his resignation, by Mr. Lowe and his successor. It is undoubtedly to Sir James that we owe the training colleges and the pupil teacher system, without which it would have been impracticable for us to advance educationally even as we have done. At the close of the year 1849 he received a baronetcy at the recommendation of Lord Russell, then Prime Minister. In 1870 he received the honorary degree of D.C.L. from the University of Oxford.

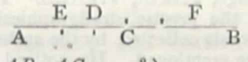
SPELLING REFORM.—An influential Conference on English Spelling Reform was held on Tuesday at the Society of Arts, under the presidency of the Rev. A. H. Sayce and Sir Charles Reed. Many weighty reasons were urged against the present system, and a deputation consisting of Prof. Max Müller, the Rev. A. H. Sayce, Dr. Morris, Mr. Ellis, Mr. Sweet, Dr. Murray and others, was appointed to wait upon the Education Department in reference to the subject. A proposal having the support of such names as we have mentioned deserves at least serious consideration.

A SIBERIAN UNIVERSITY.—It has been finally decided that the New Siberian University, to which we referred some time since, is to be established at Omsk. So long ago as 1803 a wealthy Uralian landowner named Demidoff gave 100,000 roubles to the Treasury, to be expended in the establishment of a University. This sum has now swollen to 150,000 roubles, to which a Siberian merchant has added 100,000 roubles more. Orders have been issued to begin the construction of the university buildings at once, so as to have them ready for occupation by July, 1880. The estimated cost of the future professional staff, together with other incidental expenses connected with the university, is 307,000 roubles yearly.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, May 10.—Lord Rayleigh, F.R.S., president, in the chair.—Mr. Tucker communicated a short account of a paper by Dr. Hirst on the correlation of two planes. In a former paper on the subject (*Proceedings*, vol. v., p. 40), the nature and properties were described first, of an ordinary correlation satisfying any eight given conditions; secondly, of an exceptional correlation of the first order, possessing either a singular point or a singular line in each plane, and satisfying seven conditions; and thirdly, of an exceptional correlation of the second order, having in each plane not only a singular point but also a singular line passing through that point, and satisfying six conditions. Moreover, the two following numerical relations were established between the (π, λ) exceptional correlations of the first order, with singular points and singular lines respectively, which satisfy any seven conditions, and the (μ, ν) ordinary correlations, which, besides satisfying these same conditions, possess a given pair of conjugate points or conjugate lines respectively $(2\nu = \mu + \pi, 2\mu = \nu + \lambda)$. It was by means of these relations that the number of ordinary correlations was determined which satisfy any eight elementary conditions. Before they could be applied, however, the exceptional correlations of the first order which satisfy any seven elementary conditions) had to be directly determined, and this determination not unfrequently necessitated the consideration of the projective properties of curves of high order. In the present paper the writer shows that the object just referred to can be attained in a very much simpler manner by means of two general relations, hitherto unobserved, connecting the number of exceptional correlations of the second order, which satisfy any six conditions, with the numbers of exceptional correlations of the first order which, besides satisfying the six conditions in question, possess a given pair either of conjugate points or conjugate lines.—The secretary then read part of a paper by Prof. H. Lamb, of the University of Adelaide, on the free motion of a solid through an infinite mass of liquid. Suppose that we have a solid body of any form immersed in an infinite mass of perfect liquid, that motion is produced in this system from rest by the action of any set of impulsive forces applied to the solid, and that the system is then left to itself. The equations of motion of a body under these circumstances have been investigated independently by Thomson and by Kirchhoff, and completely integrated for certain special forms of the body. The object of the present communication is, in the first place, to examine the various kinds of permanent or *steady* motion of which the body is capable, without making any restrictions as to its form or constitution; and, in the second, to show that when the initiating impulses reduce to a couple only, the complete determination of the motion can be made to depend upon equations identical in form with Euler's well-known equations of motion of a perfectly free rigid body about its centre of inertia, although the interpretation of the solution is naturally more complex. Free use is made throughout the paper of the ideas and the nomenclature of the theory of screws as developed and established by Dr. Ball.—Herr Weichold (Head-master of the Johanneum, Zittau, Saxony) sent a paper (read in part by the secretary) containing a solution of the irreducible case, *i.e.*, of the problem to express the three roots of a complete equation of the third degree, in the case of *all* these roots being *real*, directly in terms of its coefficients, by means of purely algebraical and really performable operations, whose number shall always be limited, except in the case where all these roots are incommensurable.—Mr. H. Hart made three communications: First On the "Kinematic Paradox."—Prof. Sylvester has described a system of Peaucellier's cells, the poles of which all move in a straight line, but two of which not directly connected always remained at a constant distance. Such a result is very easily obtained by means of the following relations connecting six points A, B, C, D, E, F, lying on a straight line. If

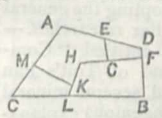


$$\left.\begin{aligned} AB\,.\,AC &= a^2 \\ BC\,.\,BD &= 4a^2 \\ EB\,.\,ED &= a^2 \\ FA\,.\,FE &= 2a^2 \end{aligned}\right\} \text{ then } FB = a.$$

He then spoke on the solution of the algebraical equation $f(x) = 0$ by linkwork, considering three points, the preparation of the equation (put under the form $\frac{A}{x+a} + \frac{B}{x+b} + \ldots = k$), the representation of the terms of this equation, and the method of adding these terms. He showed that for the solution of the cubic $x^3 + px^2 + qx + r = e$, treated under the form—

$$x + p + \frac{\left(q - \frac{r}{p}\right)x}{x^2 + \frac{r}{p}} = 0,$$

two reciprocators alone are required. He then spoke on the production of circular and rectilinear motion. The particular problem considered, he thus enunciated "to find if possible the relations that must exist between the fourteen segments of the bars placed as in the figure in order that the system may be capable of free motion." He showed that seven equations can be obtained connecting the fourteen quantities only, so that any seven being given, the remaining seven can be determined in terms of them.—Mr. Hart then proceeded to the application to the cases of 5-bar motion, laid before the Society at its April meeting. Mr. Kempe stated that the cases submitted by Mr. Hart at the previous meeting had also occupied some of his attention, and he proceeded to remark that he had determined the positions that the lines GE, KM must have, and that the determination of one involved the determination of the other, as the position of either turned upon the fact that the angles at A and H must be equal. Prof. Cayley also made a few remarks on the subject. Mr. J. W. L. Glaisher stated that he had had all the cases in which there are more than fifty consecutive composite numbers looked out from Burckhardt's and Dase's tables, which cover six millions, and that he had found that in the first million there is a stretch of 111 numbers without a prime (about 310,000), and a stretch of 113 numbers without a prime (about 500,000); so that there are two very long sets of composite



numbers in the first million, and these are longer, he thought, than anyone would have supposed likely. He exhibited the lists from which he drew the above results. Questions were put to the meeting, for information, by Profs. Cayley and Clifford.

Geological Society, May 9.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—James Dorrington, Rev. E. R. Lewis, Edward Penton, Henry Rosales, and Henry White were elected fellows of the Society.—On the Agassizian genera *Amblypterus*, *Palæoniscus*, *Gyrolepis*, and *Pygopterus*, by Ramsay H. Traquair, F.R.S.E. The author's object in this paper was to discuss the characters by which the above genera of fossil fishes have been supposed to be distinguished in the case of specimens from the carboniferous series.—On the circinate vernation, fructification, and varieties of *Sphenopteris affinis*, and on *Staphylopteris* (?) *peachii*, Etheridge and Balfour, a genus of plants new to British rocks, by C. W. Peach, A.L.S., communicated by Robert Etheridge, F.R.S., V.P.G.S.—On the occurrence of a Macrurous Decapod (*Anthrapalæmon woodwardi*, sp. nov.) in the red sandstone, or lowest group of the carboniferous formation in the south-east of Scotland, by Robert Etheridge, jun., F.G.S. After giving a detailed bibliography of the palæozoic malacostracous crustacea, the author described the remains of a small crustacean from the lower group of the carboniferous formation near Dunbar, and discussed its affinities and systematic position, which he regarded as being among the Macrurous Decapods, although the absence of the eyes in the preserved specimens, and some other characters, rendered it doubtful whether it might not in some respects approach the Stomapoda. Its position among the Macrura seemed, however, to be established by the well-developed abdominal somites and telson. He referred the fossil to Salter's genus, *Anthrapalæmon*, and named the species *A. woodwardi*.—On the stratigraphical position of the corals of the Lias of the Midland and Western Counties of England and of South Wales, by R. F. Tomes, communicated by R. Etheridge, F.R.S., V.P.G.S. The object of this paper was to give the precise stratigraphical position of the species of liassic corals collected by the author and his friends in the districts above mentioned. He noticed forty-one species, of which fifteen were described as new.

PARIS

Academy of Sciences, May 21.—M. Peligot in the chair.—The following papers were read:—Meridian observations of small planets at the Paris Observatory during the first quarter of 1877, by M. LeVerrier.—On Gay-Lussac's law of volumes, by M. H. St. Claire Deville. He considers recent researches have neither invalidated nor added to the law.—On an algebraic method for obtaining the *ensemble* of the fundamental variants and co-variants of a binary form, and of any combination of binary forms (continued), by Mr. Sylvester.—Report on M. Roudaire's project of making an interior sea in the south of Tunisia and the Province of Constantine. M. Favé reports favourably; but on the points, whether the sea would not dry up, whether the vapours would benefit neighbouring lands and not be carried to the sea by winds, and whether the eastern Algerian and Tunisian climate would recover its old fertility, and be improved hygienically, MM. Daubrée and Dumas (while adopting the general conclusions) express hesitation, and desire further researches.—Report on a memoir of M. Stanislas Meunier, entitled "Composition and Origin of the Diamantiferous Sand of Toit's Pan (in South Africa). M. Meunier has separated several mineral species not before noticed there, and offers an ingenious explanation of the way of filling up those vertical pits.—On the employment of oxygen of high tension as a process of physiological investigation; poisons and virus, by M. Bert. There is in anthracic blood a toxical and virulent principle which resists the action of compressed oxygen and alcohol, and which can be isolated like diastase. M. Bert is studying its nature and its relation to the bacteria. Lymph, too, and the pus of glanders, by resisting compressed oxygen, show that their virulent action is not due to living beings or cells.—On the employment of rotatory discs for the study of coloured sensations, by M. Rosenstiehl.—Dehydrated oxalic acid may serve to characterise polyatomic alcohols; chemical function of inosite, by M. Lorin.—Decomposition of chlorhydrate of trimethylamine by heat, by M. Vincent. This substance might be utilised to give ammoniacal products and pure chloride of methyl, the latter yielding the methylated aniline colours or pure methylic alcohol.—Observations of a disease of the vine known commonly as *white*, by Mr. Schnetzler.—New spectroscopic method, by Mr. Langley. Two spectra from the north and south poles of the sun respectively are put in juxtaposition (a considerable dispersion being used); let the instrument be adjusted so that the lines in both are continuous. On turning the spectroscope round its axis of collimation till the light comes from the east and west extremities of the equator the solar lines are displaced, while the atmospheric remain continuous. On turning 180° the spectra glide on one another like a Vernier on a scale. The point is, *simultaneous* observation of the *different* displacement of the solar and the atmospheric lines in the two spectra.—On a transmission of motion, by M. Rozé.—On the spectrum of the electric spark in a compressed gas, by M. Cazin. From experiments on air and nitrogen he concludes that the electric spark in a gas is similar to an ordinary hydrocarbon flame. In each there are luminous particles giving a spectrum of lines, and solid or liquid particles giving a continuous spectrum. The latter (in the case of the spark) come from the electrodes and the walls. When the pressure is increased these particles are more abundant; the continuous spectrum becomes more brilliant, and finally makes the linear spectrum disappear. The luminous spark called an *aureole* is of gaseous particles, and is to the total spark what the blue base of a candle flame is to the entire flame.—Studies on organ pipes, by M. Philbert.—On some new models of radiometers, by Mr. Crookes.—Thermo-chemical study of aniline and some other bodies of the same group, by M. Louguinine.—On the nitrates of bismuth, by M. Yvon.—On the properties of resorcine; molecular volumes, by M. Calderon. Resorcine in solution behaves as if it were solid and isolated from the solvent. In presence of water and potash it absorbs oxygen, though very slowly.—Anatomical characters of the blood in new-born infants during the first days of life, by M. Hayem. *Inter alia*, the red corpuscles are much more unequal in size than in the adult, and seem of a different composition. The number (in a cubic metre) is nearly as high as in the most vigorous adult. The number of white corpuscles is three or four times as great as in an adult. When the infant has reached its minimum weight (about the third day) the number of these suddenly falls; various fluctuations ensue (which are described).—On a process for estimation of alcohol in liquids, by M. Fleury.—On the filling of fissures in chalk with silex, by M. Robert.—M. Vinot presented a celestial map of the equatorial region.

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