THURSDAY, AUGUST 7, 1879

SCIENCE TEACHING IN SCHOOLS

SIR JOHN LUBBOCK, one of the two or three members of Parliament who know what science means, has again brought forward his motion for the introduction of science teaching into schools. As on former occasions, the motion was lost, though those who opposed it, and especially those connected with the Education Department, were at a loss to give any clear reason for not agreeing to it. One of the chief reasons apparently why the Department is afraid to hold out inducements for the teaching of scientific subjects, is that there is scarcely an inspector qualified to examine on the subject, a humiliating revelation of the lamentable state of education at our universities. But Sir John Lubbock also pointed out another apparently trivial but really powerful reason for our half-educated rulers shrinking from assenting to the introduction of science teaching into schools; the very name "science" acts as a bugbear. It is indeed a pity we have no such word as *Naturkunde* to indicate the sort of thing—"Natural Knowledge"—that Sir John Lubbock and the intelligent minority who are with him, wish to be taught to the boys and girls of our elementary schools. The fact is that what is wanted is a knowledge of things instead of mere words; it is really a question of how to use the eyes and how to train the mind; the pages of nature as opposed to the pages of a book; in brief, education *versus* mere instruction. How deeply working men feel the want of natural knowledge when they grow up is shown by the increasing number of technical schools that are springing up, evening classes for the teaching of science, popular scientific lectures, local scientific societies, and other similar efforts to make up for a deficient education in youth. It seems simply incomprehensible how any member of Parliament having at heart the real welfare of the people, physical, intellectual, and moral, should not heartily support Sir John Lubbock's attempt to give something like reality to our elementary education. Even the opponents of the motion seem to approve of "object-lessons," ignorant that science teaching, in Sir John Lubbock's acceptation, is just the same thing "writ large,"—simply object-lessons taught by competent teachers in a systematic and accurate manner. As to the outcry against increasing the burdens of teachers and pupils, those who raised it must have known that it was quite irrelevant. The advocates of science teaching do not wish to make it an additional, but only an alternative subject, to be taken at the option of the teachers, for grammar, geography, or other existing subject, for which payment is made. For indeed already is science put down as one of the subjects in elementary schools, but only as an extra subject for which no payment will be made, and for the teaching of which, therefore, no inducement is held out to the teachers. Then as to cost, Sir John Lubbock told the House—"Contrary to what was believed in some quarters, his proposal would really not involve any appreciable cost. The little books would come to no more than those on history or grammar; while the sun, moon, and stars, rain and dew, wind and light, air and water, heat and cold, stones and flowers, were before us all: and even if a few objects as illustrations were required, they could be obtained for a few shillings. He wished for nothing difficult or abstruse, nothing beyond the range of the children's minds and daily experience. In mechanics the simple forces might be explained to them—why carts were put on wheels, how levers and pulleys acted, the use of the screw and wedge; then the nature and relative distances of the principal heavenly bodies, the primary facts relating to air and water in agricultural districts, the character of the soil, the reason for the rotation of crops, the origin and principal qualities of such substances as chalk, coal, iron, copper, &c.; the succession of the seasons, the flow of rivers, the growth of plants; the fundamental rules of health, the necessity for ventilation and cleanliness, and last, not least, the need for industry, frugality, and economy. Explanations of these simple and every-day things would be most interesting and useful to the children. So far from cramming and confusing them, you would introduce light and order into their little minds, and give them an interest in their lessons which under the present system they rarely felt."

And, as Dr. Playfair put it, of what use was it to spend a long time in teaching children in mining districts grammar? Would it not be of greater importance to teach them about the dangers they would have to meet in their calling—about fire-damp and after-damp, for instance? In the same way, should not a child destined to become an agricultural labourer be taught something about the earth, the properties of manure, and other subjects connected with cultivation?

The fact is that some means should be taken to enlighten members of Parliament themselves as to what education, as contradistinguished from instruction, and natural knowledge, as contradistinguished from book knowledge, really is; and our readers might do worse at the certainly approaching election than arouse the minds of candidates to the urgent necessity of bringing the country, in the matter of science teaching, up to the level of those countries which, by the superior knowledge of their manufacturers and technical skill of their working men, are rapidly outstripping us on our own ground.

MAUDSLEY'S "PATHOLOGY OF MIND"

The Pathology of Mind. Third Edition. By Henry Maudsley, M.D. (London: Macmillan and Co., 1879.)

GREAT as has been the growth, in recent years, o the tree of knowledge, there is no branch in which it has undergone so much actual development, as well as mere expansion, as that of psychology. Though formerly nearly isolated, being as it were but imperfectly grafted on to the main stock, curious rather than beautiful, looking irregular, dry, and withered by the blight of theology and bad metaphysics, it now presents a compact system of branches and foliage, arranged with all the symmetry of organisation; the main stem springing from the branch of biology as this does, in its turn, from that of the physical sciences; moreover, the process is still continuing, for fresh buds may be seen in the newly-formed structures, some of which, *e.g.*, sociology, philology, æsthetics, and the science of religious beliefs are already beginning to unfold. The causes of this accelerated growth it is needless here to discuss; the principal seems to be the gradually extended application of natural law which has taken place since the impulse it received long ago from Descartes; the more immediate causes being the greater development which biology has undergone, through both induction and deduction; and especially the advances made in the physiology of the nervous system, by which a clearer understanding has been obtained of the correspondence between consciousness and bodily state. It has come to be perceived that mind, instead of being considered as a substance superadded to the body, or even as the power of consciously knowing and acting, is better regarded as the power, more extensive than the field of reflection, which highly organised beings possess, of performing their most complex actions; this regulation of action being vested in the nervous system as its peculiar function. Thus, mind appears homogeneous with life—being power similar in kind, but differing in degree of speciality. Still, the eternal mystery of the connection of consciousness with the objects of consciousness remains almost the same; the gulf still gapes widely, and cannot be bridged, though perhaps its borders may be a little more clearly defined. Also, it may still be open to discussion whether an organism possesses these remarkable powers *necessarily*—*i.e.*, in virtue of its organisation.

The development of the science having proceeded so far, it might be considered not unreasonable to look for fruit on it already, in the shape of immediate practical application; and the belief that this search had been successful was the *raison d'être* of the first appearance of this work, as the author explains in his preface. Certainly some may consider the fruit as yet unripe, or at any rate the seed it contains unready for germination, but this would be matter of individual taste. For it is at least extremely probable that if mind be a function of the body, its health will depend on laws and conditions similar to those of the other vital functions; and that when disordered, similar methods of restoration will be serviceable in either case. But the common psychological doctrines were, till lately, quite inadequate to show in what mental disease consisted. Certain affinities with other diseases had long been recognised, *e.g.*, its dependence upon certain general bodily states, or being induced by definite causes; also the prominent features of pain, excitability, and weakness, separately or together, frequently characterised the derangement of other functions also. The author shows that the correspondence may be traced still further: that, like many other morbid conditions, insanity consists essentially in failure to attain to, or retrograde departure from, the normal stage of development. But in one respect especially the present edition claims and is entitled to some degree of novelty, or even originality; namely, in the recognition of the particular mental faculty which suffers lesion in insanity. Until pointed out by Comte, Spencer, and Lewes, how large a proportion of our total environment is constituted by society, sufficient attention had not been paid to the extensive position occupied by that faculty of the mind employed in regulating our actions in relation to the social medium. Just as the motion of a planet may be resolved into a purely individual movement of rotation, and an orbital movement which it performs as member of a system, so the activities of the human mind are partly concerned with the individual alone, partly dependent on the presence of other members of a system. The latter class absorb by far the greater part of the total activity, and really constitute the chief differentia between the mind of man and that of animals, comprising those altruistic impulses which are the highest development of our activity, as is well shown in Spencer's "Principles of Psychology"; but, like all recent highly developed faculties, they do not appear in the individual completely formed at first, but in a germinal state, requiring training and exercise to bring them to the condition of full perfection; and because of their difficult development are more prone to suffer degeneration. This notion forms the foundation of the theories of education and of insanity, the latter showing that when the higher functions fail to be developed, or fall into abeyance, their place is taken by less developed faculties, which preceded them in order of evolution; or, to return to the analogy employed above, the rotatory gains at the expense of the orbital movement. This view of faculties of higher and lower faculties, *i.e.*, of greater and less perfection, and their somewhat mutual opposition, is essentially the same as Spinoza's theory of ethics. It is the key-note of the present volume, the substance of which consists of the attempt to show its existence in nature.

If the execution of the book were as satisfactory as its conception, it would indeed deserve most unqualified praise; but it is impossible not to feel, on perusal of the work, that in many respects there is much shortcoming, leaving room for further improvement, the aim not being realised owing to the difficulty of the passage from the abstract to the concrete. For though the highest generalities appear correct, are clearly stated, and well enforced, yet there is much dearth of the less general laws—the "middle propositions" which Bacon describes as of such importance in understanding the details of a subject, and of such value in practice—the absence of which is acknowledged by the author, when he says that we do not at all know why the disease should present different aspects in different cases. Also, different parts of the book are of unequal value, the best decidedly being those devoted to pure psychology and mental pathology, in which varieties of character, morbid tendencies, and the various motives, impulses, feelings, &c., are discussed, the author finding abundant occasion to display his talents as a moralist and eloquence as a writer. Next in order of merit come the sections on the phenomena and treatment of insanity; the former of these, though clear, correct, and tolerably full, do not add much to what has been written by previous observers. Lastly comes the physical aspect of the subject, which seems decidedly weak; for though this is undoubtedly most obscure, yet there is much repetition of somewhat crude theories of the correspondence of physical with psychical states. The general pathology, too, is but feebly represented; it may, perhaps, be no worse than is usual in modern text-books, but its usefulness is greatly impaired by want of those invaluable "middle propositions" which are created by clinical genius and communicated by tradition.

The first chapters are new, and are devoted to the consideration of sleep, dreaming, somnambulism, hypnotism, &c., which, being states analogous to insanity, though more open to observation, might be looked to for illustration and explanation of the leading problems of the disease, *e.g.*, its nature and genesis. In this way, the author approaches the subject of delusion, which really, in its widest sense, may be said to constitute the essence of insanity; this problem is twofold: 1. What is the primary *mental* deviation? 2. On what bodily disturbance does this depend? The intellectual is shown to be convertible into and dependent upon emotional disturbance; and it is well demonstrated how much our state of feeling—whether temporary as mood, or permanent as character—influences not only the imagination, but even perception. A delusion may be regarded as a picture formed to suit a certain frame of mind. In showing how incorrect figures arise from morbid feelings, the author is less explicit; he adopts the sensationalist or association theory, but a clearer notion might probably be afforded by a more Platonic or idealistic theory of cognition, of which there even is some suggestion once or twice. Although the author adopts the emotional source of delusion as a rule, yet he makes—rightly or not—exception in certain examples of hallucination, *e.g.*, those arising in connection with epilepsy, some toxic conditions, and in childhood—which he assigns to primary derangement of the sensory centres. Owing to the defective state of general pathology, as before stated, the mode of dependence of feeling on corporeal condition is far from being satisfactory. Next follow long chapters on the causation and prevention of insanity, treated first on the psychical, then on the physical, aspect; in both, much stress is laid on heredity as a factor: the former contains the most interesting and original parts of the work. The rest of the volume is of more special and technical character, being given to a tolerably full and accurate description of the disease, which is regarded as fundamentally the same in all cases, though wearing some variety of aspects, thus affording matter for classification; that here adopted is the same as in previous editions: the description commences with a chapter on the insanity of early life, and concludes with one upon treatment, on which the author holds rather sceptical opinions concerning the efficacy of drugs, especially narcotics.

In conclusion we may remark that, although the author may be considered to have attained success in his chief aim—the setting forth of the pathology of mind—yet no more than a mere outline has been accomplished, and much of this appears to have been derived from borrowed rather than purely original ideas, the chief originality of the author lying in their present application; and it is to be regretted that it is so lacking in thoroughness, for this may suffice to prevent an otherwise highly-readable and well-designed book from acquiring extensive adoption as a text-book and permanence as a work of reference.

LUBBOCK'S SCIENTIFIC LECTURES

Scientific Lectures. By Sir John Lubbock, Bart., M.P., D.C.L., LL.D., &c. (London: Macmillan and Co., 1879.)

THE six lectures of which this volume consists treat of the relations of insects and plants, the habits of ants, and prehistoric archæology. They are well illustrated by numerous woodcuts, and are written in the clear and pleasing style which characterises all Sir John Lubbock's works.

The first lecture—On Flowers and Insects—gives an excellent account of some of the more interesting cases of the special adaptation of flowers for insect fertilisation, but contains nothing that will be new to the readers of NATURE. The next—On Plants and Insects—introduces us to a variety of interesting and less generally known relations between the insect and vegetable worlds, which serve to confirm in a striking manner the general axiom, that the minutest details in the structure of living things, are or have been of use to them. We learn now how much of what gives a special character to many plants—their hairy or woolly stems, their spines, their glutinosity, the hairy rings inside their flowers, their drooping habit or glossy surfaces—are all of use in various ways to keep off insects which would rob them of their honey or pollen without effecting fertilisation. Another relation here dwelt upon is that of the colouring of caterpillars in accordance with the plants they feed upon, and it is particularly instructive as showing how impossible it is to decide whether a creature is protected by its colour unless it is observed in its native haunts. Few objects are more beautiful, or more varied in colour and markings, than the caterpillars of our different species of hawk-moths. They are often adorned with the most exquisite violet, blue, or white markings on a green ground, and sometimes also with ocellated spots of brilliant colours, yet in most cases these are so arranged and balanced as to harmonise with the general tints of the foliage and flowers of the food plant and thus render the insect quite inconspicuous at a little distance. In addition to the excellent woodcuts of caterpillars which illustrate this part of the work there is a coloured frontispiece which appears to have been added as an afterthought, for not only is there no reference to it in the text, but not even the names of the insects are given on the plate itself.

The next two lectures—On the Habits of Ants—give an excellent summary of those interesting researches by which Sir John Lubbock has added so much to our knowledge of these insects. Especially curious are the illustrations of the stupidity of some ants. One species is such a confirmed slave-owner that it dies of hunger if not fed by its slaves—a fact recorded by Huber and confirmed by our modern observer. Even more striking as an example of want of intellect is the experiment recorded at p. 81, where some ants went round a distance of ten feet to get at honey rather than jump down about one-third of an inch; and although they tried to reach this small height, from a little heap of earth to the glass on which the honey was placed, and could even touch it with their antennæ, yet they had not sense enough to pile up the earth a little higher but gave it up in despair and went round by the paper bridge ten feet in length!

Numerous experiments show that some sense analogous to smell, rather than vision, guides ants to their food, and thus no actual power of communication from one ant to another is needed to account for the numbers that follow when one has found out a store. Some very ingenious experiments prove, however, that an actual communication does exist when larvæ are concerned, and that one ant is able to tell its fellows whether there are few or many larvæ to be attended to. The experiments as to the effects of coloured light on ants are interesting, showing that they have a great dislike to violet light however obscure, and a preference for dark green and red; but we can hardly tell whether this effect depends on any visual perception, or on a general sense of discomfort in the one case and pleasure in the other analogous to the effects of heat and cold upon ourselves.

The last two lectures give a clear and condensed summary of the present state of our knowledge as to prehistoric man, and are well worthy of study by those who may be inclined to doubt the value of the conclusions arrived at by the new science of Prehistoric Archæology. There is here of course nothing but what is well known to all who have paid attention to the subject. It is, however, interesting to note how sharp and striking the contrast between the Palæolithic and Neolithic ages appears, when their characteristic features are briefly summed up side by side as we here find them. Whether we consider the tools, weapons, and other works of art, the character of the contemporary animals, the physical geography of the country, or the distribution of man himself, we cannot but be impressed with the profound chasm, which in Europe at least, separated the Palæolithic from the Neolithic man. And as, since the glacial epoch passed away we have no evidence of any physical changes calculated to produce such a chasm, it seems natural to suppose that it was the result of the cold period itself, and that, as many geologists now maintain, Palæolithic man lived before the glacial epoch and during interglacial mild periods, while Neolithic man made his first appearance only when the ice-age had finally passed away. On any other theory we have no adequate cause adduced for a discontinuity so vast in its proportions and extending over so wide an area. A. R. W.

OUR BOOK SHELF

Dairy Farming; or, The Theory, Practice, and Methods of Dairying. By J. P. Sheldon, assisted by leading authorities in various countries. Part I. (London: Cassell, Petter, and Galpin, 1879.)

THE prospectus of this work promises us a thorough treatment of all parts of the important subject of dairy farming. The selection, breeding, and feeding of dairy cows; the production, treatment, and disposal of butter and cheese; the plants or crops used in feeding animals; dairy buildings, and soils adapted for dairy farms; such are some of the subjects embraced in the scheme of Mr. Sheldon's serial work, the publication of which, in monthly parts, has recently commenced. The first number, being chiefly occupied with general introductory remarks, hardly affords a fair sample of what the bulk of the book is likely to be. These prefatory pages do, however, contain a good deal of interesting matter—matter important to many persons besides dairy farmers. Some of the statistics of milk- and cheese-production here given are very striking. For instance, we are told (p. 9) that about 500,000 tons of ripe cheese could be made from the milk annually produced in the United Kingdom, when the quantity of milk required for rearing and fattening calves has been deducted. But, in point of fact, much milk is consumed as such in food, while from that which is submitted to further dairy operations a good deal of butter is made. The approximate estimates, therefore, for the amounts of milk and milk-products in question will stand somewhat as follows for the United Kingdom:—Milk annually consumed as such, 525,000,000 gallons; 126,000 tons ripe cheese from 350,000,000 gallons; 89,295 tons of butter from 550,000,000 gallons. When the cheese, butter, and condensed milk imported from abroad are added to the home production, some notion of the vastness of the amount of dairy products consumed by the population of the British Isles may be gained. Thus, 98,000 tons of cheese are annually brought into this country from the Continent, the United States, and Canada; while the yearly import of butter approaches 90,000 tons. The value of our imports of butter and cheese together is just 15,000,000*l*. sterling.

It seems somewhat ungracious to say one word in disparagement of any part of an undertaking which promises so well as does Mr. Sheldon's "Dairy Farming." But we feel bound to hint that more care should be taken in securing the accuracy of any physiological and chemical explanations that it may be thought expedient to introduce into the volume. The figures and statements on pp. vi. and vii. of the "Introduction" require revision. We give an instance. We are told (p. vi.) that 1 lb. of milk contains ·65 ounce of flesh-formers and 1·51 ounce of heat-givers. Now the latter figure has been reached by adding together the fat and sugar of the milk without the previous conversion of the former into its starch-equivalent. It is needless after this to say how idle are all the subsequent comparisons of milk with other foods, vegetable and animal.

Marcus Ward's Arithmetic. J. W. Marshall, M.A., Assistant-Master at Charterhouse School. (London: Ward and Co., 1879. 232 pp.)

THIS is a neatly got up arithmetic; it contains a great number of exercises, covering the usual ground occupied by such treatises, has a modicum of explanatory matter, and calls for no further comment. There are no answers at the end, but they can be got in a separate form.

A Collection of Problems on Plane Geometrical Drawing, including Problems on a few of the Higher Plane Curves, &c. By E. F. Mondy, A.R.S.M. 2 vols. Text and Plates. (Tokei. 127 and ix. pp.)

A COLLECTION of problems arranged for the use of the students in the Imperial College of Engineering, by the First Whitworth Scholar (1871), and Professor of Drawing in the College. The author's aim has been to arrange the earlier problems so as to render it of service to students to work these while reading Wilson's Geometry, the text-book used in the Mathematical Class. The treatment is mainly founded upon the recognised English text-books, but a novel feature, perhaps, is the extent of space devoted to the conic sections and the higher plane curves, "especially as regards the use of equations to these curves and to the various geometrical elements connected with them."

Thus constructions are given for the tangents and radii of curvature, and problems in areas are worked out.

The book is, under the circumstances, very fairly got up as regards the printers' work, and the matter is deserving of commendation for its arrangement.

Our own experience of Japanese students is that they take very kindly to this branch of mathematical instruction, and the productions of some we could name rank among the neatest we have seen. The plates are in a separate work from the text, a convenience in some respects for the student.

Essai sur les Principes fondamentaux de la Géomètrie et de la Mécanique. Par M. de Tilly. (Paris: 1878. 190 pp.)

THIS valuable treatise forms the first *cahier* of the third volume of the *Mémoires de la Société des Sciences physiques et naturelles de Bordeaux*, 2^e^ série. The first chapter—General Geometry—discusses the elementary notions and axioms of the subject in a way that will satisfy an anti-Euclidian, but we fear the nerves of Euclidian adherents would suffer a shock at the bare-faced manner in which triangles and figures are moved about and turned about and placed upon one another.

The second chapter treats of the subject as handled in the Elementary Treatises, taking chiefly for the basis of remarks the fourth edition of the Geometry, by Messrs. Rouché and De Comberousse.

Chapters III. and IV. are occupied with Trigonometry, and Chapter V., closing the work, treats of Mechanics. The volume is too technical to allow of an extended criticism here, but we can commend it to geometrical students. No statement is made as to how it comes to pass that such a volume was issued under the auspices of the Society named above.

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.*]

New Methods of Moving Ordnance

In anticipation of an interesting paper and discussion at the intended meeting of the British Association at Sheffield, a complete set of working models has been prepared at the Floating Dock, North Shields, to explain several new applications of a new method of moving ordnance with ease and rapidity of motion in small space, with economy of time and labour.

The most recent of these improvements is an adaptation of the principles of the tramway and tram car, in making use of the perfectly level surface, and the retaining groove, either on the ship's deck or on the platform of a battery. But instead of flanges on the wheels, that have a tendency to clog and compress dirt into the grooves, and "gag" on the edges, a hanging longitudinal guide-plate projects below the wheels on the inside of the rails; this allows greater freedom of action to the wheel and gives greater security, and in order to attain greater power of resistance to any shock or concussion, the guide plates are strengthened by a cross connecting the plate between them. The gun carriage slide has turn-table pivots on four wheels, that can be placed anywhere; as for the real or imaginary centres of motion at the ends, or centrally or to correspond with the present A B C D pivots of the Royal Artillery, which when in line or parallel or at any angle to each other act as stationary or moving pivots or fulcra for a lever movement of the slide, to turn or move in any direction on perfectly straight lines, as the shortest route between any two points, and also as best adapted for the application of a direct action of any of the usual mechanical motive powers.

North Shields, August 1 GEORGE FAWCUS

"Law of Frequency"

THE term "law of frequency" seems to be used in two distinct senses by mathematical writers. In the ordinary theory the ambiguity leads to little confusion except to beginners; but this is owing to a fortunate, though altogether special, property of the hypothesis on which the theory is based. When we come to investigate other possible theories, it becomes highly important to keep the distinction in mind. Suppose, for clearness' sake, that we have before us a large number of measurements of a single unknown quantity. On examining them we find that a considerable number agree pretty closely with each other, several are more obviously discrepant, while one or two are widely so. Conversely we are led to think of the frequency with which a given measurement occurs as a function of the magnitude of the measurement itself. Denoting this magnitude by x, we may represent the relative frequency of its occurrence by $\phi(x)$. This function is called the "law of frequency of the measurement x," and it is in this sense that statisticians often use the phrase.

But if we consider all the possible measurements that may be made of the quantity, we see that their number is practically infinite. The relative frequency of any proposed measurement becomes therefore infinitesimal, and we must seek for some other expression. This we find by inverting our ideas, as it were, and asking, not "What is the frequency of a given measurement x?" but "What is the probability that a given measurement shall lie between the two very near values x and $x + \delta x$?" Suppose that our particular theory gives us this latter probability as $\psi(x)\,\delta x$. Then mathematicians generally are wont to call $\psi(x)$ "the law of frequency of the measurement x."

A little consideration will show that on one hypothesis only are $\phi(x)$ and $\psi(x)$ necessarily of the same form. This hypothesis is that the arithmetic mean of our fallible measurements is the best value of the quantity measured which we can obtain from them. From this the ordinary law, $\phi(x) \propto e^{-h^2x^2}$, easily follows.

But if the nature of our measurements (or other discrepant magnitudes) be such as to suggest that some other mean is likely to be nearer the truth than the arithmetic mean, we shall find that the forms of $\phi(x)$ and $\psi(x)$ are not the same. It seems, therefore, desirable that a real distinction in the things signified should be marked by a corresponding distinction in the terms applied to them. If it be not too bold a suggestion, might we not "desynonymise" the terms "law of frequency" and "law of facility," keeping the former for the function I have called $\phi(x)$, and the latter for the commoner function I have represented by $\psi(x)$? DONALD MCALISTER

St. John's College, Cambridge, July 28

Carica Papaya

THANKS to Mr. Whitmee for his timely correction of my perhaps too dogmatic assertion as to the seeds of the Papau being rejected by birds, at p. 241. Had I not written off-hand I should have qualified the sentence "the birds however will not touch them," *i.e.* the fruit, by adding "as far as I have observed."

We had flocks of small birds inhabiting the casuerinas and banyans which shaded our sea-side quarters at Rivière Noire, Mauritius; they were mostly small birds such as "bengalis," (*Estrelda amandava*), "senegalis," (*Estrelda astrilda*), "calfats," (*Munia oryzivora*) "tuit-tuits," (*Oxynotus ferrugineus*), cardinals, crithagras, serins, &c., as numerous as finches and sparrows in our English gardens: but never did I see any of these birds, which were as bold and tame as possible, peck at the papaus either on the plants or on the ground; had they been in the habit of doing so I must have observed them. The "martins" or minas of the interior did not trouble us with their visits and noisy chatterings, so I cannot say whether they affect the papau seeds much. It is possible that the "pigeons marrons" and various "tourterelles" may have fed on the papau fruit but I never found any of the seeds in their crops.

The flying foxes, "collets rouges," (*Pteropus Edwarsii*), used to come down in numbers to eat the mangoes of our neighbour, Mons. Genève; when we used to shoot them on moonlight nights and find them remarkably good eating, but I never knew or heard of their eating the papau, which perhaps they do. The conditions of the Mascarene and Navigator's islands are probably different, as the *Carica* certainly does not spring up as a weed wherever forests are cleared in Mauritius, or Bourbon. The *Carica papaya* figures as a *cultivated* and not an *intrusive* plant in Dr. Charles Pickering's table of observed localities of plants introduced throughout Polynesia; distinguishing for each plant, whether it appears to be native, or spontaneously disseminated, and whether when introduced apparently by the hand of man it has become naturalised or *intrusive*. Certainly Dr. Pickering's work is out of date (1848), and I have not yet seen his new work *Chronological History of Plants* (Trübner, 1879).

Whilst on this subject I may subjoin a paragraph I came across in a number of the *Gardener's Chronicle* about the papau, with which I conclude.

"*Utilisation of the Papaw.*—The peculiar properties of the Papaw (*Carica papaya*) in causing the separation of animal tissues, and thus rendering newly-killed meat tender, is a fact that has been frequently written about and commented upon by travellers. Our contemporary, *The Chemist and Druggist*, suggests, as a 'possible specialty,' the production of some convenient preparation from the tree which should contain the same properties as the leaves, or whether the leaves themselves might be dried and still retain their activity. 'There is no doubt,' they say, 'that a preparation which really embodied these virtues would be very popular, and that it would soon become one of the necessaries of life, without which no careful housekeeper would allow herself to be left.' It is further pointed out that, as the tree is abundant, and the expense of collecting the leaves would probably be very small, it would be quite worth while to procure a quantity either of the leaves or the juice from the West Indies, and endeavour to obtain a suitable preparation therefrom. If the leaves are brought they might be packed fresh in barrels, which should be filled with salt water—not sea water —and in this way imported; 'or the juice might be expressed from them and saturated with salt, or preserved with benzoic or salicylic acid, and sent over in any convenient vessels. Experience would prove if they would retain these properties when so treated.' These hints may be worth the consideration of some of our readers in countries where the Papaw is abundant."

Anglesey, Gosport, August 4 S. P. OLIVER

The Pacific Salmon

THE reviewer of the U.S. Fisheries' Commission Report, 1875-6, in NATURE, vol. xix. p. 429, pointedly refers with doubt to a statement that "so far as yet observed the adult fish of the Pacific salmon (*Salmo quinnat*) all die after spawning" quoted from a memorandum which I wrote on the subject for the information of the New Zealand Government.

In support of this I would refer to the evidence given in a previous volume of the same reports, 1872-3, p. 191 and elsewhere. This phenomenon, remarkable though it be, is so entirely in accordance with my own observations made during two seasons spent on the upper waters of the Columbia river in 1859-60, and with the opinions I heard expressed by Indians and trappers, that I thought I was justified in mentioning it as a peculiarity of importance.

It may interest your readers to learn that a million of salmon ova of this species have been imported to New Zealand, and that over 700,000 have been hatched and that some 40 rivers have been stocked with the young fish.

Through the great liberality of the American Government at the instance of Prof. Spencer Baird, this invaluable addition to the future food resources of the Colony, has been effected at the cost of only a few hundred pounds to the Colonial Government.

JAMES HECTOR

Colonial Museum of New Zealand, Wellington, May 10

A New Spectroscope

IN NATURE, vol. xx. p. 256, a description of M. Cornu's spectroscope for observation of the ultra-violet rays is given.

The lens of the collimator, and that of the observing telescope are said to be composed of a double convex lens of quartz achromatized by means of a plano-concave of Iceland spar, both cut parallel to the optical axis. His prisms are said to be of quartz.

Will you allow me to state that I have used an exactly similar arrangement for the last three years, with the exception that the two prisms are of Iceland spar, which has higher dispersive power. The object glasses were ground and polished for me by Mr. Ahrens of the Liverpool Road. I named the plan about two years ago to my friend Prof. McLeod, and have found it very successful in working. WILLIAM H. STONE

14, Dean's Yard, Westminster, S.W., August 4

"The Rights of an Animal"

I BELIEVE that when a writer feels himself to have been entirely misrepresented by his reviewer, editorial fairness allows him, at least in such journals as admit correspondence, to set himself right with the reader. The reviewer of my "Rights of an Animal" in NATURE, vol. xx. p. 287, says that, when I claim for animals "the *same* abstract rights of life and personal liberty with man," I use an ambiguous word which casts its shadow over the entire work and makes it unsatisfactory. I should have thought "same" clearly meant "identical." My reviewer says that this cannot be my meaning, because I allow animals to be killed for food and to be worked. He forgets that I have shown how the law of self-preservation overrules the rights both of animals and of men, that it warrants our checking breeding in animals, and that the animals which I allow to be killed or worked were only allowed to come into life for those purposes.

He says that I consider it "immoral to eat shrimps and lobsters." I have indeed asked how we are to defend the killing of "fresh- or salt-water fish or crustaceans," but I have suggested an answer, and have merely added "is this plea sound?" That I leave a question doubtful does not justify a reviewer in saying that I decide it in a particular way.

I will not follow him into an argument between a very sophistical "philosopher" and a very stupid lobster, wherein the former gains an inglorious victory; but, when he in his proper person reproduces, anent another question, one of the philosopher's arguments, and charges me with "the same inconsistency of principle"—because "if man has a moral right to slay a harmful animal *in order to better his own condition*, he must surely have a similar right to slay a harmless animal, *if by so doing he can secure a similar end*"—I must protest that "principle" and "self-interest" are not synonymous, and that a writer who can pen such a sentence is no more capable of reviewing an ethical essay than I of reviewing a book on diamagnetism.

Lastly, he has (even in transcribing my title-page) omitted all mention of my reprints from Lawrence's interesting and very scarce work, and has conveyed to the reader an impression that my book consists of only about 60 pp., an impression very damaging to the chance of the reader buying or even borrowing it. EDWARD B. NICHOLSON

London Institution

Intellect in Brutes

MR. HENSLOW's question (NATURE, vol. xix. p. 433) reminds me of the celebrated carp and bucket of water problem, put by King Charles the Second. He had better have put it thus—"Did ever a person know a dog (or other animal) ring a bell to bring a servant, &c." How can any one tell if an animal goes through any "process of reasoning," save by the results? What will Mr. Henslow say to the following, for which I can vouch, as can others now living? For my part, having watched animals since my childhood, I am fully convinced of their "powers of reasoning" to a certain extent.

Many years ago we lived in Cambridge, in Emmanuel House, at the back of Emmanuel College. The premises were partly cut off from the road by a high wall; the body of the house stood back some little distance. A high trellis, dividing off the garden, ran from the entrance door to the wall, in which was another door, or gate. A portion of the house, a gable, faced the trellis. These particulars are necessary, as you will see.

We were, after some time of residence, extremely troubled by "run-away-rings," generally most prevalent at night, and in rainy, bad, or cold weather, which was a great annoyance to the servant girls, who had to cross the space between the house and the wall, to open the outer door in the latter, and were thus exposed to wet and cold.

The annoyance became so great that at length a cousin and myself, armed with wicked ash saplings, watched behind the trees on "Jesus' Piece," bent on administering a sound thrashing to the enemy, whoever he was, that disturbed our "domestic peace." *Mirabile dictu!* the rings continued, but no one pulled the bell handle! Being a very old house, they were now of course set down to ghosts! but not believing in those gentry, I was puzzled. Chance, however, revealed the originator of the scare.

Being ill I was confined to the wing facing the trellis, and one miserable, blowing, wet day, gazing disconsolately out of the window, espied my favourite cat—a singularly intelligent animal, much petted—coming along the path, wet, draggle-tailed, and miserable.

Pussy marched up to the house-door, sniffed at it, pushed it, mewed, but finding it firmly shut, clambered up to the top of the trellis, some eight or ten feet from the ground, reached a paw over the edge, scratched till she found the bell-wire which ran along the upper rail from the wall to the house, caught hold of it, gave it a hearty pull, then jumped down, and waited demurely at the door. Out came the maid, in rushed Puss. The former, after gazing vaguely up and down the street, returned, muttering "blessings," no doubt, on the ghost, to be confronted by me in the hall.

"Well, Lydia, I have at last found out who rings the bell." "Lard, Master! ye harvent sure*ly*"—she was broad "Zamerzetsheer." "I have; come and see. Look out of the breakfast room window, but don't show yourself." Meanwhile, I went into the drawing-room, where Mrs. Puss was busy drying herself before the fire. Catching her up, I popped her outside of the door, and ran round to my post of observation.

Puss tried the door, and mewed, thinking, probably, some one must be near, and after waiting two or three minutes in vain, again sprang up the trellis, and renewed her attack on the bell-wire, of course to be immediately admitted by the delighted maid, who this time did *not* cross the yard, nor ever again, I fear sometimes to the inconvenience of visitors, if puss was waiting for admission.

Now I think Mr. Henslow will concede that no one ever taught that cat how to ring the bell by *pulling the wire*. To my mind she must have gone through the following process of reasoning:—1. She noticed whenever the bell rang the door opened. 2. In clambering up the trellis to the house-top she accidentally moved the wire, and caused the bell to ring. This probably occurred several times before she noticed it, but having once done so, she repeated it, purposely, whenever she wanted entrance; I have often made her do it for the amusement of friends, by turning her out from her snug nest by the fire on cold or wet days.

I have known dogs shake a door violently to attract attention and be let in. A dear old spaniel of ours, at the Cape, used to rattle the empty bucket if he was thirsty, and then come and look in our faces. My horse will come up from his pasture to the pump in the yard and whinny till some one gives him water. I have known several dogs rear up and place their paws on the old-fashioned "thumb-latch," and let themselves in. Surely all this is "abstract reasoning"? These things are not taught them, and they do not do all of them, even by imitation. I don't go to the pump and whinny, if I want drink! nor rattle a bucket! No! they come by a process of mental reasoning, and I am convinced all animals have it to a certain degree, more or less. I could multiply instances by the page-full, but have already taken up too much space. Among others I could confirm the gnawing of water-pipes by rats to get at the water.

Brit. Consulate, Noumea, May 30 E. L. LAYARD

As a contribution to the doubtless numerous cases in which dogs have recognised the representations in paintings, I put on record the following fact:—

I have in my possession a small picture in which several dogs are represented; a small spaniel was frequently found standing on a chair before the picture and barking at it, and this was the only picture of which he took any notice. P. B. M.

Black Lizards

FROM the interesting letters of Messrs. Giglioli and Ernst it appears that lizards are found of a black colour where, according to received ideas, they ought to be nearly white. How is this anomaly to be explained?

With all due respect to those who have made this subject their study for tens of years, it seems to me that they keep too exclusively to one single proposition, which may be thus enunciated: *An organism is made to prey or be preyed upon.* What I am inclined to maintain is that an unfavourable climate is the common enemy of all, an enemy that must be eluded. If an animal be thrown into a climate too hot, or too cold, it will die if it cannot speedily adapt itself to its altered surroundings. We see a mild case of this adaptation to environment in man himself, the pale-face of temperate zones becoming soon in torrid zones bronzed, and, after a few generations, black. The black dermal covering is therefore clearly the one which is best adapted for extreme heat.

I submit then that here we have the case of the lizards simply stated. On the sandy beaches of Los Roques and Orchila, covered with a very scanty vegetation the pitiless rays of the sun must fall on the lizards in a most uncomfortable manner, to say nothing of the heat reflected and radiated from the ground itself. From the moment the islands were separated from the mainland, a change would commence in the lizards to suit them to their altered position, a change which has resulted in their present wide divergence from the mainland type so far as colour is concerned. WM. ACKROYD

Sowerby Bridge, July 31

Spicula in Helix

THE spicula observed by your correspondent (NATURE, vol. xx. p. 316) lying underneath the albuminiparous gland in some specimens of *Helix aspersa* are probably Spicula Amoris. Their calcareous composition if coupled with a quadrangular outline would establish the fact. PAUL HENRY STOKOE

Beddington Park

Distribution of Black Rat

IT may interest Mr. Middleton to know that in 1866, the black rat was abundant on the top of the Island of Ascension; below, the "House of Hanover" held sway. I counted about a dozen, lying in a manure pit, that had been killed in the farm stables, during the previous two or three days, and was told by a soldier, who did not think them anything out of the way, that "there were plenty of them." E. L. LAYARD

Noumea, May 31

ON THE STRUCTURE OF THE STYLASTERIDÆ: A FAMILY OF HYDROID STONY CORALS[1]

UNTIL the late Prof. Agassiz in 1859 announced his discovery that the Milleporidæ were Hydroids and not Anthozoans, it was confidently believed that all living recent stony corals were most closely allied in their essential structure to the common sea anemones of our coasts. The majority of stony corals still remain under the old category. The beautiful calcareous branched or variously formed objects so familiar as ornaments or as exhibits in museums are nearly all of them formed within the bodies of animals which differ in no important features from the flower-like anemones of our aquariums. The sea anemones have no hard skeleton to support their soft and yielding bodies; the corals differ from them in that they have such skeletons. These are, during the life of the animals of which they form part, entirely embedded within the soft tissues, and only become exposed and appear in the familiar form when the animals are dead and their flesh has been removed from their bones by the action of decomposition or more speedy solution by means of caustic alkalis.

It seems difficult to explain how the popular error by which corals are spoken of as structures built up by coral "insects" arose. It is still perpetuated with considerable misleading detail in some schoolroom books, and it is quite common to meet still with educated persons who regard coral as analogous to honeycomb, and look upon it as built up by the "insects" in much the same sort of way.

Very many corals are solitary or simple, being the skeletons of single animals. As an example may be cited the mushroom-coral, the common chimney ornament, which is the largest known simple coral. This is the skeleton of a single animal comparable with and closely allied to a sea anemone. By far the greater number of forms of corals are, however, compound; that is to say, they are the skeletons of colonies of animals, each comparable to a single mushroom coral but living united together for mutual benefit and with their skeletons fused together to form a common support. Such are for example the various branched Madreporas and other similar forms, and the brain-corals so often brought home from the tropics by sailors.

Until Prof. Agassiz made the discovery above alluded to it was supposed that all stony corals were, as above described, Anthozoan. He found, however, to the astonishment of naturalists, that the corals known as the Milleporidæ were the skeletons of animals allied not to the sea anemones, but to the jelly-fish or Medusæ and the common Hydra of our fresh-water ponds and ditches. The Milleporidæ, of which there are very many species, which, however, fall within but a single genus, Millepora, are either branched and form shrub-like or antler-like masses of various sizes, or occur as irregular rounded lumps, often spreading in their growth over dead corals or other objects, and encrusting them. The Millepores are distin-

[1] The Croonian Lecture, 1878.

guished by the fineness and abundance of the minute pores by which the surfaces of their skeletons are pierced. The animals belonging to these corals had not been examined until they were investigated by Agassiz, and as he was not able to make any extended investigation of their structure, his results were long accepted by many naturalists with considerable hesitation. During the voyage of H.M.S. *Challenger* I studied the structure of several species of Millepora in detail, with the result of confirming Prof. Agassiz's results and yielding a detailed account of the minute structure of these organisms, which is almost complete, excepting with regard to their generative organs, which remain as yet entirely unknown.

In pursuing my observations on corals, I discovered that another family of stony corals, as well as the Milleporidæ, is also Hydroid in structure. This is the family of the Stylasteridæ, an account of the structure of which was selected by the Royal Society as the Croonian lecture for last year, and has just appeared in the new volume of the *Philosophical Transactions*. In the present article I have brought together the principal results of interest which are stated in detail in the lecture.

One of the Stylasteridæ (Allopora) had previously been examined in the living condition by Prof. G. O. Sars, and Sars had suspected that this coral might be Hydroid like the Milleporidæ, but he had been unable to work out the details of the structure of the organism and to prove the matter with certainty. Several observers, the late Dr. Gray, Prof. Verrill, and the Count de Pourtales, had observed the distinctness of the Stylasteridæ, and noticed that there were remarkable peculiarities characterising this family of corals.

The Hydroid stony corals, the Milleporidæ and Stylasteridæ, I have placed in a special sub-order, the Hydrocorallinæ. Though the two families are well distinguished from one another, they show many close resemblances in structure.

Amongst the Hydrocorallinæ there do not exist, as there do amongst the Anthozoan corals, any simple or solitary species; there are no Hydroid corals comparable thus to the mushroom corals, the only forms known are compound colonies. In the case of the Anthozoan corals it seems probable that in the progress of development a simple ancestral form derived from a sea-anemone developed a calcareous skeleton, and that from this solitary form compound corals were derived as subsequent modifications; or, rather, it is not unlikely that several solitary ancestors developed calcareous skeletons independently, and that from each of them different compound forms resulted. In the case of the Hydrocorallinæ, on the other hand, it seems probable that the calcareous skeleton was first developed as a support to already formed colonies, and that no solitary ancestor with a calcareous support preceded them.

Almost all the recent Anthozoan corals belong to the Hexactinia or corals which, like the common sea anemones, have the radially disposed soft structures of their bodies and the corresponding radial plates of their skeletons arranged in multiples of the number six. These Hexactinian Anthozoan corals are termed the Madreporaria. It is a very remarkable f ct that amongst all the vast number of species of compo d Madreporaria known, there seems to exist no instance of a modification of certain of the animals composing the colonies by a subdivision of labour amongst them for the general good to the colony. Amongst Alcyonarian corals and Hydroid corals such a sub-division of labour exists, but for some reason or other such high specialisation seems never to have been attained amongst Madreporaria.

In the case of the Hydrocorallinæ, the subdivision of labour amongst the members of the colonies is carried to a most interesting perfection. It reaches considerable completeness in the Milleporidæ, but in the more advanced Stylasteridæ attains a most elaborate complexity.

In all the Hydrocorallinæ the hard skeleton is very porous, being traversed in all directions by canals which branch and join one another in all directions. Within these canals are lodged corresponding branching and anastomosing tubes composed of soft tissues, which form a complex meshwork within the coral mass, and convey a general circulation common to all the members of the colony. In all the Hydrocorallinæ two kinds of polyps or zooids occur. The more numerous kind are devoid of any mouth or stomach, and act simply as catchers of food for the colony. These are hence termed dactylozooids. The less numerous kind have each a mouth and stomach, and are hence termed gastrozooids; they receive the food from the dactylozooids, and swallow it, and their bases being in direct communication with the general circulation, they nourish with the results of their digestion the dactylozooids and all the component parts of their colony.

In the Milleporidæ the dactylozooids, when expanded, are long and slender, and are provided all along their lengths with short tentacles each of which bears a knob at its end. In the case of the Stylasteridæ, however, the dactylozooids have quite lost their tentacles, and are simply long, slender, tapering bodies, reduced to the aspect of simple tentacles themselves. In the Milleporidæ the gastrozooids are provided with short tentacles round their mouths, and such tentacles are also present in the case of the gastrozooids of most of the genera of Stylasteridæ, the number present varying in the case of each genus. In some genera of Stylasteridæ, however, even the gastrozooids have lost their tentacles, and remain as simple cylindrical digestive sacs; in these instances the entire colonies are devoid of tentacles altogether.

The zooids are lodged within pits or pores on the surfaces of the corals, which are termed gastropores or dactylopores, according to the kind of zooid belonging to them. The gastropores are larger than the dactylopores in correspondence with the size of the respective zooids. In most species of Millepora and several genera of Stylasteridæ the gastropores and dactylopores, intermingled with one another, are scattered irregularly all over the surfaces of the corals; but in one species of Millepora occurring at Tahiti the pores are gathered with some considerable regularity into circular groups, each of which is composed of a single centrally-placed gastropore and a surrounding zone of six or seven dactylopores. In this case the zone of dactylozooids in each group or system ministers to the wants of the single gastrozooid of that system.

The complexity of relations of the zooids advances no further in the case of the Milleporidæ, but in that of the Stylasteridæ many additional complications exist. In several genera (*Allopora*, *Stylaster*, *Cryptohelia*, *Astylus*) the pores occur only in regular circular systems, which are termed cyclosystems. In each of these cyclosystems there is a deep centrally-placed gastropore and a circular zone of from five to upwards of twenty dactylopores. The mouths of the dactylopores, instead of being circular in outline, are drawn out into the forms of long slits, which are disposed in the cyclosystems in a regular radial manner towards the central gastropore. In species in which the dactylopores are numerous and closely packed in the systems, a thin wall only of hard coral skeleton is left intervening between them. Hence each system has closely the appearance of an ordinary Anthozoon coral cup, with its radiating septal plates, and so close is the resemblance that Gray and all earlier observers did not doubt that Stylaster and its allies were essentially similar in structure to the ordinary branching corals, such as Oculina.

The essential difference between a cyclosystem of a Stylasterid and an Anthozoan coral cup is, however, as wide as possible. The radiating plates in the case of the Anthozoan coral are skeletal structures developed within the body of a single polyp, whereas the so similar-looking radiating plates in the case of the cyclosystem are skeletal plates developed outside the bodies of the numerous component polyps altogether, and separating a number of adjacent polyps from one another. The peculiar radiate form of the cyclosystems of the Stylasterids has no doubt been gradually developed as the result of the constant bending inwards of the dactylozooids in each system to reach their gastrozooid when further and further retracted within its pore. The dactylozooids have thus in course of generations pulled the mouths of their pores out into the form of slits all directed inwards towards the gastropore in each system. In the case of some genera the gastrozooids have carried matters so far that they have ceased to be retracted within their own pores when at rest, but double themselves inwards for safety within the wide mouths of their gastropores. In one genus (Cryptohelia) a further protection is afforded to the zooids by the growth in front of each system of a delicate lid-like lamina of hard coral skeleton, which projects in front, and shields all the zooids when retracted.

In some genera of Stylasteridæ the zooids are not gathered into cyclosystems at all, but various other complications occur. Thus, in some genera there are two kinds of dactylozooids, larger and smaller. The larger and longer, in order to gain more reach in procuring food, are borne at the tips of long spine-like projections of the hard skeletons of the corals, whilst the smaller dactylozooids are lodged in small pores at the bases of these spines where they are in close proximity to the gastrozooids. The larger dactylozooids presumably catch the food, and are helped in delivering it to the gastrozooids by their shorter companions.

As before stated, the mode of generation of the Milleporidæ is as yet unknown, but it is certain that it differs in one important particular from that of the Stylasteridæ. In these latter small cavities, or brood pouches, termed ampullæ, are formed in the hard skeleton of the coral, and in these the generative elements are developed. Each coral stock is of separate sex, all its components being either male or female. The walls of the ampullæ in many cases project above the surfaces of the corals, and are especially prominent in female stocks, since they have in these cases to contain large embryos. In some specimens of Stylasteridæ the ampullæ are very conspicuous to the naked eye, looking like small convex blisters closely packed on the surfaces of the coral branches. They are particularly well marked in the case of female stocks of species of Distichopora, which are thus especially serviceable for class demonstration, and when the generative function of the ampullæ is premised, afford evidence at a glance of the hydroid nature of the Stylasteridæ. The ova are developed within the ampullæ to the condition of mature planulæ, when they are set free by the gradual thinning and final rupture of the ampullar walls and swim off to start fresh colonies. It is highly probable that the masses of tissue from which the ova are developed, and which protect them during growth, are representatives of polyps, which have, like the dactylozooids, lost their mouths, and have come by restriction of function to be mere egg-bags as it were.

In all the Stylasteridæ, even those with very complex cyclosystems, there is a complete circulatory connection between the different systems and all parts of the colony, as well as amongst the components of each system. Thus in these complex mutual benefit associations, certain members of the colonies catch the food, but do not eat it, others receive it from them and nourish the whole colony thereby, whilst others again neither catch food nor eat it, but devote themselves entirely to the production and rearing of the young.

The ancestral forms from which the Hydrocorallinæ have been developed must have been colonies closely similar in essential structure to their present descendants, but with all their component zooids provided with mouths and generative organs, all alike catching food and digesting it, and possibly all taking their share in the production of young. In such colonies further development may be conceived of as having arisen by either of two processes. All the zooids may have become gradually modified, so that each performed only one function and thus had certain of its structures aborted to fit it for this special end. If such be the history of the development of the Hydrocorallinæ then the dactylozooids are to be looked on as they have been regarded throughout this paper as representatives of zooids which in the ancestral condition were provided with a mouth and stomach, but in which these structures as well as the generative structures have become rudimentary by disuse. Similarly in the case of the gasterozooids the functions of prehension have to a large extent been lost, and the zooids have become, in some cases, mere stomachs.

On the other hand the view may be taken that the gastrozooids alone represent the original zooids of the ancestral colony. They remain, having lost their generative organs and to a greater or less extent their prehensile ones because additional zooids have been formed by budding in order to provide for the wants of the colony in these particulars. On this view the generative zooids and dactylozooids were originally budded out in the condition in which they now exist or in one not so complete as it is at present, nor so perfectly adapted to their present function. On this view they have lost no structure by disuse, but have rather advanced in complexity with development but only in their own specialised direction.

The former view of the antecedent history of the suborder Hydrocorallinæ has been here adopted, because the presence of several structures which occur as rudiments in connection with the dactylozoids and generative zooids, but which are fully developed in connection with the gastrozooids, seem to bear out this conclusion. As examples may be cited the calcareous styles which gave the name to the family Stylasteridæ. These styles are small projections of the hard skeletons of the corals which support the gastrozooids within their pores. In several genera rudimentary styles are found to occur in connection with the dactylozooids.

The Stylasteridæ, in the complexity of their compound stocks, form an interesting parallel to the Siphonophora. In the Siphonophora the several components of the compound organisms are by the best authorities regarded not as individual zooids, but as portions of the organisms which, being budded out, tend in their growth to assume more and more the form of individuals. The question is to some extent one of nomenclature, but it must not be forgotten that though the diverse elements composing the organism in the case of the Siphonophora may seem closely paralleled by those of which that of a Stylasterid is made up, the past history of the two organisms may be very different. In the one case an ancestral already compound organism may have gradually modified its similar zooids to subserve division of labour, whilst in the other a simple ancestor may have gradually developed a similar compound organism by throwing out buds of various forms, which have come more or less to approach itself in complexity. H. N. MOSELEY

IRIDO-PLATINUM

THE volume of the *procès-verbaux* of the International Commission of Weights and Measures published in Paris last year,[1] contains, among other matter of much value, an interesting appendix by MM. Sainte-Claire Deville and Stas, who were requested by the Commission to ascertain the composition of the platinum-iridium alloy employed in the preparation of the rules and cylinders

[1] Gauthier-Villars. Paris, 1878.

destined to serve as the International Prototype Standards. Their investigations are set forth at great length, and analytical chemistry is thus enriched by an elaborate memoir, in every way worthy of its distinguished authors. The alloys of platinum iridium, of which these standards are made, was furnished by Mr. George Matthey, of the well-known firm of Johnson, Matthey, and Co., and, in the April number of the *Annales de Chimie*, there is a paper by MM. Deville and Mascart, describing the experimental determinations of the various physical constants of the metal of which the Règle Géodésique is made. We cannot do better than quote their words as indicating the care and skill bestowed by Mr. Matthey in the preparation of this standard: "En fabriquant un pareil alliage avec une telle pureté, M. Matthey a résolu un problème de métallurgie des plus difficiles et des plus compliqués. On ne peut s'imaginer, à moins qu'on ne connaisse dans tous leurs détails les procédés si pénibles employés à la purification de l'iridium et même du platine, combien il a fallu d'intelligence, de patience et de dévouement à la Science pour réussir dans une pareille œuvre." [1]

As the matter is of much importance, a paper recently communicated to the Royal Society by Mr. G. Matthey possesses special interest, as in it he describes the methods employed for preparing the metals in a state of purity. The following is an abstract:—

"The six metals (of which platinum is the chief) usually found more or less in association, present characteristics of interest beyond their metallurgical utility, which are, perhaps, worth alluding to. It is, for instance, a curious fact that the group should consist of three light and three heavy metals, each division being of approximately the same specific gravity—the heavier having (in round figures) just double the density of the lighter series.

Thus we find osmium, iridium, platinum forming the first division, of the respective specific gravities of 22·43, 22·39, 21·46; whilst ruthenium, rhodium, and palladium are represented by the figures 11·40, 11·36, 11, the average densities of the heavy and light divisions thus being respectively 22·43 and 11·25.

But a more interesting and important classification is what I may designate as a first and second class series, from the more important view of their relative properties of stability. Thus platinum, palladium, and rhodium form the first or higher class, not being volatilisable in a state of oxide; iridium, osmium, and ruthenium forming the second or lower class, their oxides being more or less readily volatilised.

The oxide of iridium is affected at 700° to 800° C., and entirely decomposed at 1,000°, whilst osmic and hyporuthenic acids are volatilised at the low degree of 100°, the latter exploding at 108°. The chlorides of these metals can be sublimed at different temperatures (as also the protochloride of platinum).

Platinum

The preparation of this metal in a state of purity is an operation of extreme delicacy. I commence by taking ordinary commercial platinum; I melt this with six times its weight of lead of ascertained purity, and, after granulation, dissolve slowly in nitric acid diluted in the proportion of 1 volume to 8 of distilled water. The more readily to insure dissolution, it is well to place the granulated alloy in porcelain baskets such as are used in the manufacture of chlorine gas for holding the oxide of manganese. When the first charge of acid is sufficiently saturated, a fresh quantity should be added until no more action is apparent; at this stage the greater part of the lead will have been dissolved out, together with a portion of any copper, iron, palladium, or rhodium that may have been present. These metals are subsequently extracted from the mother-liquors, the nitrate of lead by crystallisation, and the remaining metals by well-known methods.

[1] *Ann. de Chim. et de Phys.*, 5me Série, t. xvi., April, 1879.

The metallic residue now obtained will be found in the state of an amorphous black powder (a form most suitable for further treatment), consisting of platinum, lead, and small proportions of the other metals originally present—the iridium existing as a brilliant crystalline substance insoluble in nitric acid. After digesting this compound in weak aqua regia, an immediate dissolution takes place of the platinum and lead, leaving the iridium still impure, but effecting a complete separation of the platinum.

To the chloride of platinum and lead after evaporation is added sufficient sulphuric acid to effect the precipitation of the whole of the lead as a sulphate, and the chloride of platinum, after dissolution in distilled water, is treated with an excess of chloride of ammonium and sodium, the excess being necessary in order that the precipitated yellow double salt may remain in a saturated solution of the precipitant. The whole is then heated to about 80°, and allowed to stand for some days; the ammonio-chloride of platinum will settle down as a firm deposit at the bottom of the vessel, whilst if any rhodium, as is generally the case, is present, the surface liquor will be coloured a rose tint, occasioned by a combination of the salts of the two metals.

The precipitate must be repeatedly washed with a saturated solution of chloride of ammonium and subsequently with distilled water charged with pure hydrochloric acid. This is necessary for its purification. The small quantity of the double salt which will be taken up and held in solution is of course recovered afterwards. Rhodium may still exist in the washed precipitate, which must therefore not be reduced to the metallic state until its separation is completed, and this is best effected by mixing with the dried compound salts of chloro-platinate and chloro-rhodiate of ammonia, bi-sulphate of potash with a small proportion of bi-sulphate of ammonia, and subjecting to a gradual heat brought by degrees up to a dull red in a platinum capsule, over which is placed an inverted glass funnel. The platinum is thus slowly reduced to a black spongy porous condition freed from water, nitrogen, sulphate of ammonia, and hydrocloric acid, the rhodium remaining in a soluble state as bi-sulphate of rhodium and potash, which can be dissolved out completely by digesting in boiling distilled water; a small quantity of platinum will have been taken up in the state of sulphate, but is regained by heating the residue (obtained on evaporation) to redness, which reduces it to the metallic condition, the rhodium salt remaining undecomposed.

By the method above described the platinum is freed not only from rhodium, but from all other metals with which it may have been contaminated, and is brought to a state of absolute purity, of the density 21·46, the highest degree obtainable.

Iridium

In practice, the purest iridium which can be obtained from its ordinary solution (deprived of osmium by long boiling in aqua regia and precipitated by chloride of ammonium) will almost invariably contain traces of platinum, rhodium, ruthenium, and iron.

I fuse such iridium in a fine state of division with ten times its weight of lead, keeping it in a molten state for some hours, dissolve out the lead with nitric acid, subject the residue to a prolonged digestion in aqua regia, and obtain a crystalline mass composed of iridium, rhodium, ruthenium, and iron, in a condition suitable for my further treatment. By fusion at a high temperature with an admixture of bi-sulphate of potash, the rhodium is almost entirely removed, any remaining trace being taken up together with the iron in a later operation. The iridium so far prepared is melted with ten times its weight of dry caustic potash, and three times its weight of nitre, in a gold pan or crucible; the process being prolonged for a considerable time to effect the complete transformation of the material into iridiate and rhuthenate of potash, and the oxidation of the iron; when cold, the mixture is treated with cold distilled water. The iridiate of potash of a blue tinge will remain as a deposit almost insoluble in water, more especially if slightly alkaline, and also the oxide of iron.

This precipitate must be well washed with water charged with a little potash and hypochlorite of soda until the washings are no longer coloured, and then several times with distilled water.

The blue powder is then mixed with water strongly charged with hypochlorite of soda, and allowed to remain for a time cold, then warmed in a distilling vessel, and finally brought up to boiling point until the distillate no longer colours red, weak alcohol acidulated with hydrochloric acid.

The residue is again heated with nitre and potash water charged with hypochlorite of soda and chlorine, until the last trace of ruthenium has disappeared.

Further, to carry out the purification, the blue powder (oxide of iridium) is re-dissolved in aqua regia, evaporated to dryness, re-dissolved in water, and filtered.

The dark-coloured solution thus obtained is slowly poured into a concentrated solution of soda and mixed with hypochlorite of soda, and should remain as a clear solution without any perceptible precipitate, and subjected in a distilling apparatus to a stream of chlorine gas, should not show a trace of ruthenium when hydrochloric acid and alcohol are introduced into the receiver. In this operation the chlorine precipitates the greater part of the iridium in a state of blue oxide, which, after being collected, washed, and dried, is placed in a porcelain or glass tube, and subjected to the combined action of oxide of carbon and carbonic acid obtained by means of a mixture of oxalic with sulphuric acid gently heated.

The oxide of iridium is reduced by the action of the gas leaving the oxide of iron intact, the mass is then heated to redness with bi-sulphate of potash (which will take up the iron and any remaining trace of rhodium), and after subjecting it to many washings with distilled water, the residue is washed with chlorine water to remove any trace of gold, and finally with hydrofluoric acid, in order to take out any silica which might have been accidentally introduced with the alkalies employed or have come off the vessels used.

The iridium after calcination at a strong heat in a charcoal crucible, is melted into an ingot.

Alloy of Iridio-Platinum

Operating upon a charge of 450 ounces of platinum and 55 ounces of iridium, I commenced by melting these metals together and casting into an ingot of suitable shape, which I then cut into small pieces with hydraulic machinery. After re-melting and retaining in a molten condition under a powerful flame of oxygen and common gas for a considerable time, I re-cast and forged the mass at an intense white heat under a steam hammer, the highly-polished surfaces of which were cleaned and polished after each series of blows—when sufficiently reduced the alloy was passed through bright polished steel rollers, cut into narrow strips, and again slowly melted in a properly-shaped mould, in which it was allowed to cool. I thus obtained a mass of suitable shape for forging, perfectly solid, homogeneous, free from fissures or air-holes, and with a bright and clean surface.

A piece cut from the end of a mass so prepared, was presented to the French Academy of Science, and gave the following results :—

Weight in air	116·898 grms.
,, water	111·469 ,,
Showing a density of	21·516 ,,

thus proving that the necessary processes of annealing at a high temperature had caused it to resume its original density.

The analysis gave—

	1	2
Platinum	89·40	89·42
Iridium	10·16	10·22
Rhodium	0·18	0·16
Ruthenium	0·10	0·10
Iron	0·06	0·06
	99·90	99·96

From which is deduced :—

	Proportion.	Density at zero.	Volume.
Iridio-platinum at 10 per cent.	99·33	21·575	4·603
Iridium, in excess	0·23	22·380	0·010
Rhodium	0·18	12·000	0·015
Ruthenium	0·10	12·261	0·008
Iron	0·06	7·700	0·008
	99·90		4·644

Density at zero, calculated after No. 1 analysis	21·510
Density at zero, calculated after No. 2 ,,	21·515

which coincide perfectly with the practical results obtained."

MM. Deville and Mascart find the coefficient of dilatation to be from 0° to 16° C. 0·00002541.

As we have already pointed out, work on which the accuracy of standards depends is of the highest importance, and Mr. Matthey is therefore to be congratulated on the success of his labours.

THE INFLUENCE OF THE TRANSVERSE DIMENSIONS OF ORGAN PIPES ON THE PITCH

IN NATURE, vol. xix. p. 172, Mr. Ellis gives, on the authority of M. Cavaillé-Coll, a rule determining a point of some interest in regard to organ-pipes. All those who are accustomed to organs know that the theoretical rule which makes the vibration-number of the note sounded vary inversely as the length of the pipe, does not hold correctly in practice, as the pitch is influenced by the *transverse dimensions*. A pipe of "large scale," *i.e.*, of large diameter, will speak a lower note than one of "small scale," the length of the tube being in both cases the same. I am not aware that this fact has been explained in acoustical works, or any rule given for the variation.

Mr. Ellis's formula provides for this, so far as cylindrical pipes are concerned, and he has found it to agree well with experiment. There is a misprint in his equation, which at first sight renders it somewhat obscure, and in correcting this I will venture to present M. Cavaillé-Coll's investigation more completely, as it was expressed by him in a paper presented to the Academy of Sciences many years ago, and a copy of which he was good enough to give me.

After calling attention to the theoretical rule, he remarks that the departure from it is due to the influence of the *mouth* of the pipe, *i.e.*, the rectangular opening at the lower end of the tube. He made many experiments to determine the effect of this, and came at length to the result that in open pipes of rectangular section the *effective length of the pipe* was equal to the *length of the sound-wave* due to its note [or the half wave-length according to our mode of calculation] *diminished by twice the internal depth* of the tube. By the "depth" is meant the transverse dimension from front to back; the other transverse dimension, the *width*, appearing to be of no consequence.

Thus, if S represent the velocity of sound, V the number of vibrations per second (*single* ones, according to the French mode of calculation), L the length of the pipe, taken from the lower edge of the mouth to the end of the tube; and P the internal transverse depth, then—

$$L = \frac{S}{V} - 2P.$$

M. Cavaillé-Coll gives two examples of applications he made of this formula :—

1. A wood pipe sounding what is called 4-foot C, 264 [single] vibrations per second at the normal French pitch, and having a depth of 8 centimetres, was found to have a length of $1^{m}\cdot13$. Taking the velocity of sound at $10°$ to $15°$ C. to be 340 metres per second, the equation would give—

$$\frac{340}{264} - 0\cdot16 = 1^{m}\cdot128,$$

differing only 2 millimetres from that actually found.

2. The large 32-foot pedal pipe of the organ of St. Denis was at first cut to a length of $9^{m}\cdot566$, the internal depth being $0^{m}\cdot48$. The number of single vibrations per second was intended, according to the standard pitch, to be 33, according to which the equation gave—

$$\frac{340}{33} - 0\cdot96 = 9^{m}\cdot36$$

as the calculated length. This showed the pipe to be too long, which proved to be the fact, the note being too flat. An opening was then made to reduce the effective length to that given, when the pipe was found to be in perfect tune.

In applying the formula to *cylindrical* pipes, M. Cavaillé-Coll found the same law obtain ; allowing for the difference in shape, and for the flattening of the pipe necessary to form the mouth properly, he considered that the mean depth was about equal to five-sixths the diameter, or—

$$P = \frac{5}{6} D.$$

Substituting this in the above equation it becomes, for cylindrical pipes—

$$L = \frac{S}{V} - \frac{5}{3} D.$$

Taking now the mean velocity of sound given by M. Cavaillé-Coll, namely, 340 metres or 1115 feet per second; putting the dimensions of the pipe in inches, and altering V to represent the number of *double* vibrations per second, according to our English custom ; we obtain, finally, for cylindrical pipes—

$$L = \frac{6690}{V} - \frac{5}{3} D; \text{ or}$$

$$V = \frac{20070}{3L + 5D}.$$

Mr. Ellis's rule is—

$$V = \frac{20080}{3L + 5V}.$$

the letter V, however, in the denominator being clearly a misprint for D.

The foregoing rules, it must be stated, apply to pipes *open at the end*, which constitute the great bulk of those in an organ. WILLIAM POLE

GEOGRAPHICAL NOTES

THE letter from Sir Rutherford Alcock in yesterday's *Times*, announcing the death of Mr. Keith Johnston, will be received with surprise and sincere regret. As our readers know, Mr. Johnston was leading the Geographical Society's expedition from Dar-es-Salaam to the north end of Lake Nyassa, and, if possible, thence to Tanganyika. A start was made on May 14, and now the sad news comes that the young leader died of dysentery on June 28, at Berobero, about 130 miles inland. Mr. Johnston came of a famous geographical house, and had already done good exploring work in South America. He was enthusiastic on the matter of African exploration, and was well qualified to carry it out in a scientific method. His death is a real loss to scientific geography. We are glad to learn that the expedition will be continued under the leadership of Mr. Thomson, the geologist who accompanied Mr. Johnston.

IT is with great pleasure we learn from a letter of Dr. G. Nachtigal to the editor of Petermann's *Mittheilungen*, that the announcement of Dr. G. Rohlfs' retirement from the leadership of the expedition of the German African Society was premature. He did express a wish to resign, but has since been able to overcome all initiatory difficulties, and left Benghazi with his followers on July 4, and it is hoped will be able to reach Abesh, the chief town of Wadai, about the middle of next month. Dr. Nachtigal's account of his own great exploring work in North and Central Africa from 1869 to 1874 has just been published in Berlin.

AT the last sitting of the Paris Geographical Society, M. Paul de Soleillet explained his scheme for putting Timbuctu in communication with the Atlantic. A railway must be made from Dakkar, on the Atlantic coast and St. Louis, the head city of French Senegal. This work will be begun next winter. The Senegal must be rendered navigable from St. Louis to Bafoulabé, and a canal constructed from Bafoulabé to Bamakou, on the Niger. These projects having been adopted by the High Commission, the Survey for the canal will begin immediately. The Niger is navigable without works of any description from Bamakou to Timbuctu and other places below for a distance of 1,500 miles. The aggregate expense required for the whole of the work is estimated at a million sterling, and the number of people placed in close connection with French Senegal thirty-seven millions. A M. Fourreau has sent a letter to the President of the Society stating that he, with two friends, had established a farm in Oued Bish, about 150 miles southward of Biskra, in the direction of the intended Transaharian Railway *viâ* Biskra. The exploration committee of the Saharan Railway Commission has recommended the Government to send out M. Soleillet to visit the unexplored regions between $15°$ and $25°$ N. lat.

TAKEN as a whole, the August number of the Geographical Society's monthly periodical appears to be the best that has been issued. The papers are Major Serpa Pinto's notes of his journey across Africa ; Mr. McCarthy's "Across China, from Chinkiang to Bhamo;" and the late Capt. R. R. Patterson's notes on Matabeli-land. The map of South Africa, accompanying Major Pinto's notes, is particularly interesting, as it embodies a good deal of original information. The geographical notes are unusually full and varied, and we are glad to observe that greater attention is being paid to this most essential department of a geographical magazine. Since the note on Major Tanner's exploratory visit to Kafiristan was written, news has unfortunately arrived that ill-health has compelled that officer to return to India. There is a useful summary of Dorandt's report, published by the Russian Geographical Society, on his astronomical and magnetic observations on the Lower Oxus, and of Mr. Hillier's account of his journey in North China at the beginning of this year. Climatology also claims a place among the notes. The remainder of the number is occupied with a report of the evening meetings, the proceedings of foreign societies, and notes on new books and maps.

NEWS has just been received at Copenhagen from the scientific expedition which sailed for Greenland in the *Ceres* on March 29 last. The expedition, which consists of two naval officers, MM. Jansen and R. Hammer, and a student of polytechnics, M. Kornerup, reached the Holsteinborg Colony, in Greenland, on April 30, and at once proceeded with their investigation and measurement of the coast and fjords between Holsteinborg and Egedesminde. They left the neighbourhood of Holsteinborg on May 15, travelling in small Greenland boats. From that date to the end of August, when they hope to reach Egedesminde, the explorers will have to camp in their boats or on the rocky shore. However, the summer nights are bright in those latitudes, and the expedition is well equipped with all necessaries.

ELECTRICAL CLOCKS AND CLOCKWORK

IN the year 1843 an electrical pendulum which forms the basis of nearly all succeeding systems of electrical clockwork, was patented by the late Alexander Bain. (See Fig. 1.)

The bob of the pendulum, C, consists of a coil of insulated wire. One end of the wire passes to the axis of the tumbler A T, the other, through the suspension spring S, to the plate P_1. P_1 P_2 are plates, say of zinc and carbon, and are sunk in the earth to form the battery. From P_2 a wire W_2 proceeds to N. MM is a horse-shoe magnet. Whilst AT leans against N, a current is passing, and C is

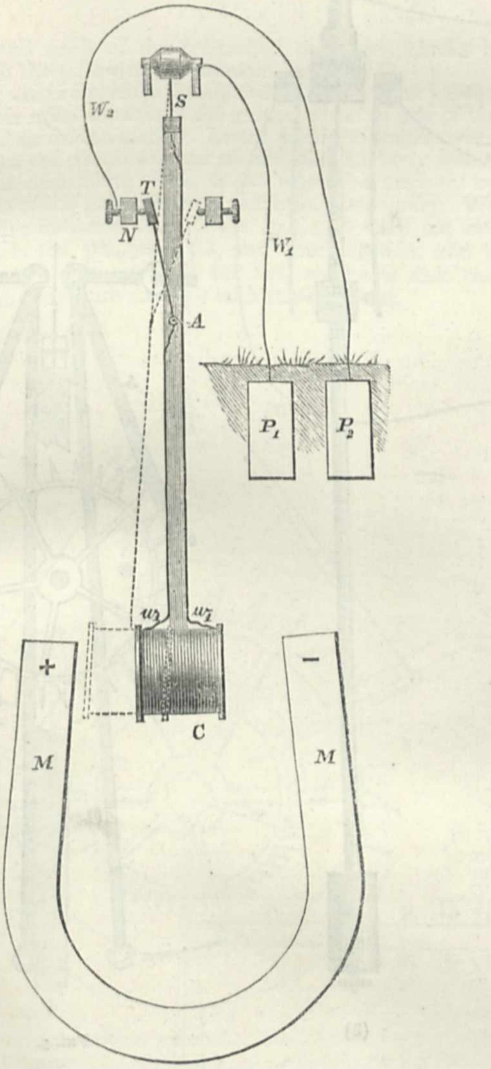

FIG. 1.

magnetic. C has its − and + poles facing the + and − poles of the horse-shoe magnet. Consequently the pendulum is driven to the left, but when it reaches a certain point, AT topples over, the current ceases, and the pendulum returns. The pendulum now proceeds on its swing to the right, but on approaching the limit of its oscillation, overturns AT again, the current is renewed, and the pendulum again propelled to the left. This action automatically repeats itself. Mr. Bain placed within the circuit of his pendulum any number of electrical dials. Fig. 2 shows the mechanism of these. C is a coil either in the line of W_1 or W_2. When a current passes C becomes magnetic, and oscillates between the magnets MM. At every swing of C a tooth, T_1, of the wheel is gathered up by the detent DD. The click, KK, by holding a tooth, T_2, prevents the wheel returning whilst D is passing to the right.

The impulse on Mr. Bain's pendulum varied with the power of his battery, a condition fatal to good timekeeping. In 1849 Mr. Shepherd patented a system in which the current was employed to lift a slight weight or

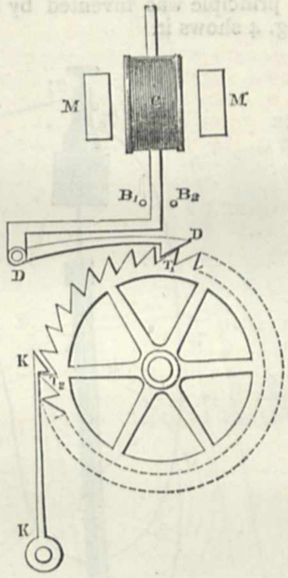

FIG. 2.

spring. The fall of this propelled his pendulum, and gave an impulse quite independent of any variation in the power of his battery. Fig. 3 shows one of his plans.

PP is the pendulum, W a weight, mounted on a lever WCA. WCA can move about a centre C, and is at present prevented from turning by the catch SS. When PP swings to the right, the lower screw in PP passes under E (see side view Z) and frees WCA. WCA, under the weight of W, propels the pendulum to the left till stopped by a

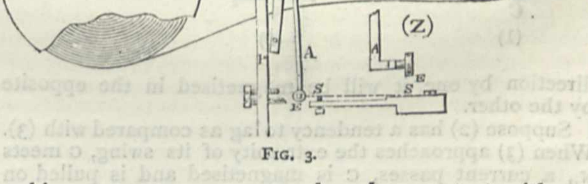

FIG. 3.

banking B. PP moves on and makes contact with T, whereupon a current passes, M_1 M_2 become magnetised, and attract LL, the vertical arm of which lifts WCA over the catch SS again. When PP leaves T the current ceases, and LL is carried back to its old position by the action of the spring R.

Mr. Bain's and Mr. Shepherd's are the leading types of electrical clocks properly so called, that is to say, of clocks which keep themselves going by electricity. But it is scarcely worth while to use electricity when you can get gravity more cheaply. And do what you will, you can never absolutely rely on getting your current when you want it. For these reasons purely electrical clocks are very seldom used, it being found better to do whatever electrical work is required, by an ordinary clock with galvanic contact apparatus affixed. But though electrical clocks pure and simple have not made much progress, the system of *controlling* a quantity of indifferent clocks from one good one has. This principle was invented by Mr. Jones, of Chester, and Fig. 4 shows it.

(3) is the pendulum of the controlling clock, and (2) that of a controlled clock; (1) is a side view of (2). C, the bob of (2) is a hollow coil of insulated wire, and swings over two magnets, M_1 M_2, which have their similar poles facing each other. The ends of the wire forming C are carried up the pendulum, pass respectively through S_1 S_2, and terminate in T_1 T_2. T_1 is joined to T, which crowns the pendulum of the controlling clock, and T_2 is in connection with both N_1 N_2, the contact springs of the same. Both N_1 N_2 have their respective batteries, B_1 B_2, but with opposite poles towards J; so that if C is magnetised in one

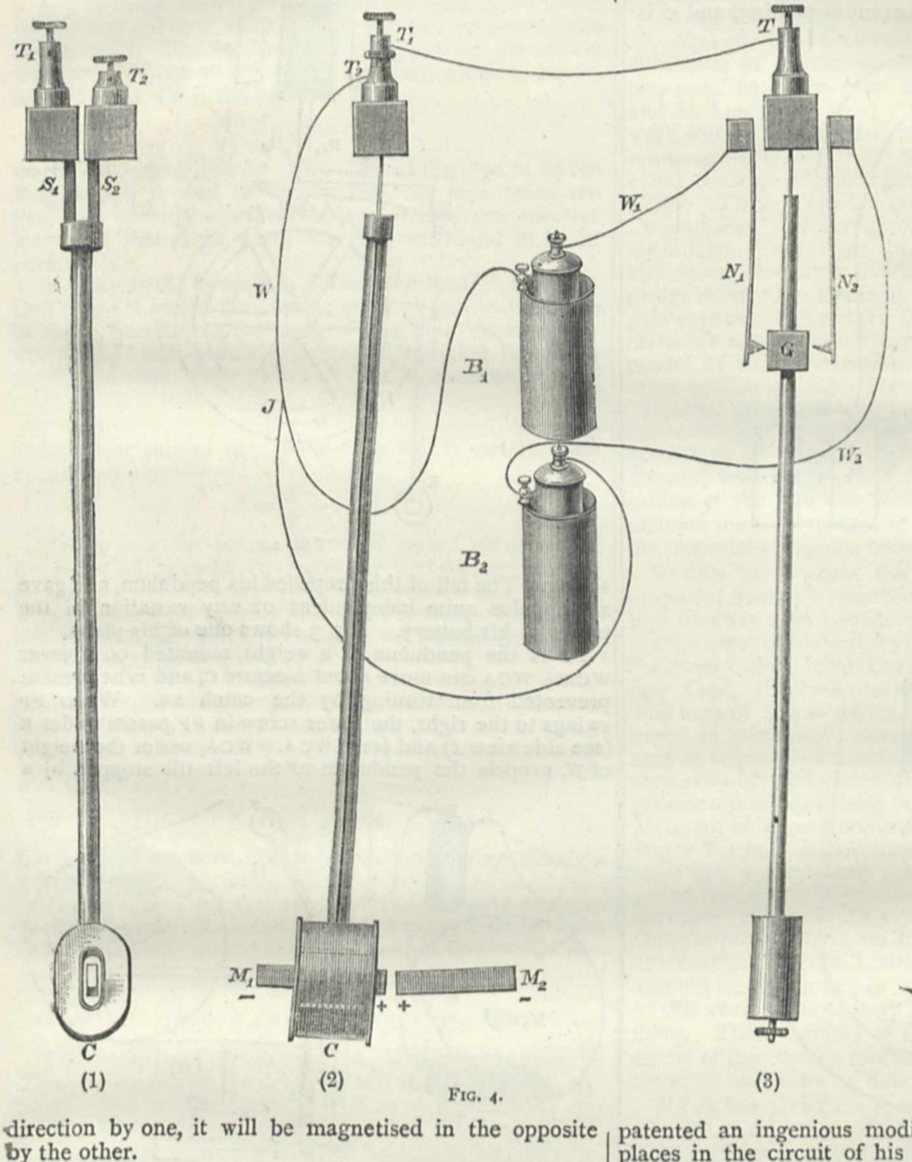

Fig. 4.

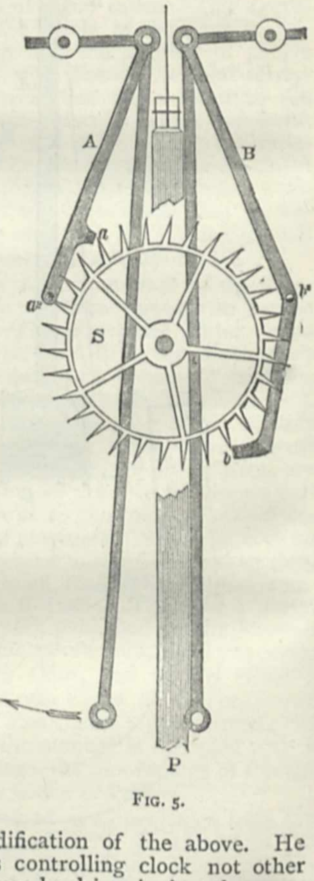

Fig. 5.

direction by one, it will be magnetised in the opposite by the other.

Suppose (2) has a tendency to lag as compared with (3). When (3) approaches the extremity of its swing, G meets N_1, a current passes, C is magnetised and is pulled on smartly. When G leaves N_1, the current ceases. G goes to meet N_2, then C, which is now over M_2, is again magnetised, but in the reverse direction. M_2 being also reversed as regards M_1, C, if behind, is pulled on again. Should (2) be in front of (3) its motion would be checked. A great many clocks can by this method be kept swinging in unison together.

Mr. Ritchie, of 25, Leith Street, Edinburgh, has patented an ingenious modification of the above. He places in the circuit of his controlling clock not other clocks, but pendulums. These he drives in just the same way as Mr. Jones controls his, and each pendulum works a train of wheels which move hands. Mr. Ritchie's are really electrical dials, but they have this great advantage, that should the current fail, as currents are apt to occasionally, the momentum of the pendulums is sufficient to keep the dials moving for a short time independently of it. The method by which the pendulums drive the wheel work is interesting (see Fig. 5).

A and B, the pallets, swing loose. S, the escape wheel, is now being held against a_2, a stop on A, by the weight of

B, which is pressing the tooth *b*. B has been deposited on *b* by the pendulum P, which is swinging to the left. Presently the pendulum lifts the vertical arm of A, and unlocks the wheel. The wheel moves on, but B falls, and the stop b_2 on B catches the tooth which is just above it. The pendulum continues its swing, and on returning, deposits A on the next succeeding tooth to *a*. It then proceeds to B, and continues the performance as before.

It is desirable that you should know that all your controlled or driven clocks are performing properly. In the circuit, alongside the standard clock, a galvanometer is

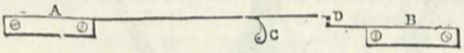

FIG. 6.

placed, and each of the controlled or driven clocks is fitted with the following mechanism (see Fig. 6).

AD, DB are two springs through which the current passes. C is a lifter upon the axis of the escape wheel of one of the controlled or driven clocks. Every minute C comes round and breaks the circuit for one second, and anybody standing at the controlling clock, knows when this happens by the needle of the galvanometer remaining stationary. We arrange, for instance, that clocks A, B, C, D shall cut out respectively the 3rd, 9th, 15th, and 40th seconds, and if these seconds are regularly cut out, we know that our controlled clocks are running with the standard.

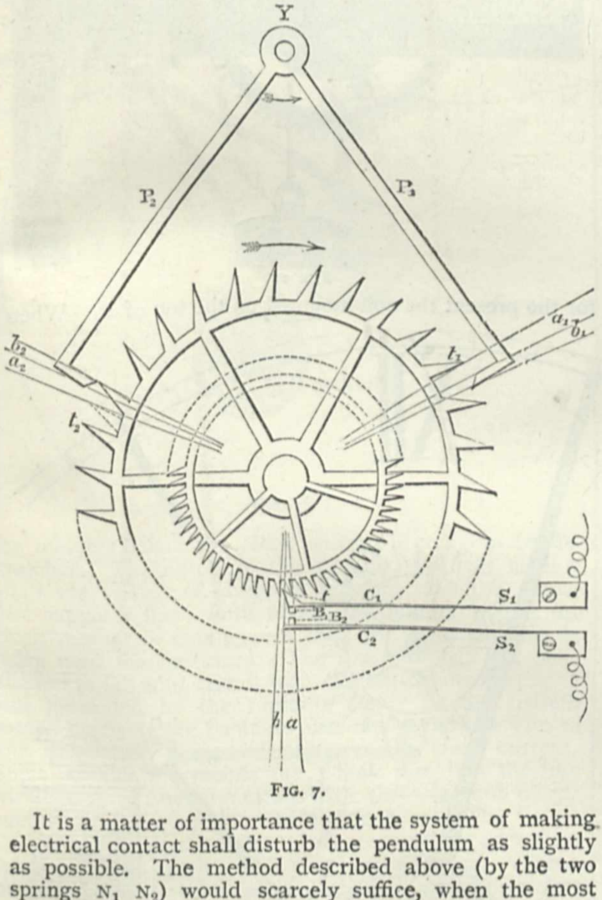

FIG. 7.

It is a matter of importance that the system of making electrical contact shall disturb the pendulum as slightly as possible. The method described above (by the two springs N_1 N_2) would scarcely suffice, when the most accurate timekeeping was required. The standard sidereal clock at Greenwich has a jewelled pin in the crutch rod which in passing zero presses two weak springs together. A better plan (Mr. Hartnup we are informed had also previously used it) seems one which has just been constructed by Messrs. Dent for some other work. In this it would appear that the resistance of the contact springs cannot affect the pendulum at all; because the springs are lifted during the drop of the escape wheel from one pallet to the other (see Fig. 7).

A tooth has just passed from the impulse face of the

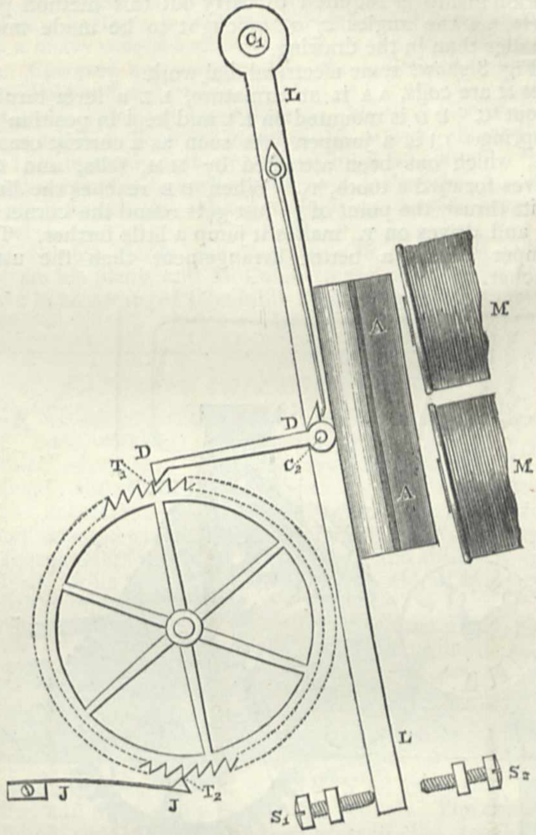

FIG. 8.

pallet P_2; t_1 now falls through the angle a_1 on to the dead face of the pallet P_1. *During this interval* the tooth *t* of the smaller wheel mounted on the same axis as the escape

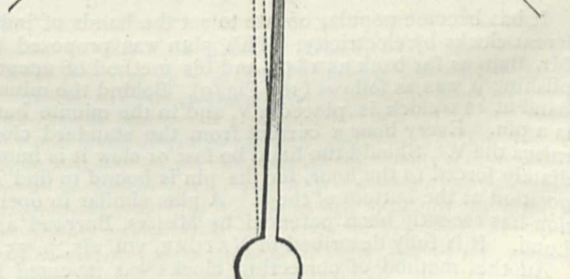

FIG. 9.

wheel lifts the contact spring C_1 S_1 against the contact spring C_2 S_2, and the current passes. It will be seen that when the tooth t_1 goes on to give impulse to the pallet

P_1 through the angle b_1, the tooth t has allowed the springs to drop, and that it travels through its corresponding angle b perfectly undisturbed. The motion of the tooth t_2 can easily be traced from the drawing. Careful workmanship is required to carry out this method properly, as the angles a, a_1, a_2 ought to be made much smaller than in the drawing.

Fig. 8 shows some electrical dial work.

M M are coils, A A is an armature, L L a lever turning about C. D D is mounted on L L and kept in position by a spring. J J is a jumper. As soon as a current ceases, L L, which has been attracted by M M, falls, and D D drives forward a tooth, T_1. When D D reaches the limit of its thrust, the point of J J just gets round the corner of T_2, and drives on T_2, makes it jump a little further. The jumper seems a better arrangement than the usual ratchet.

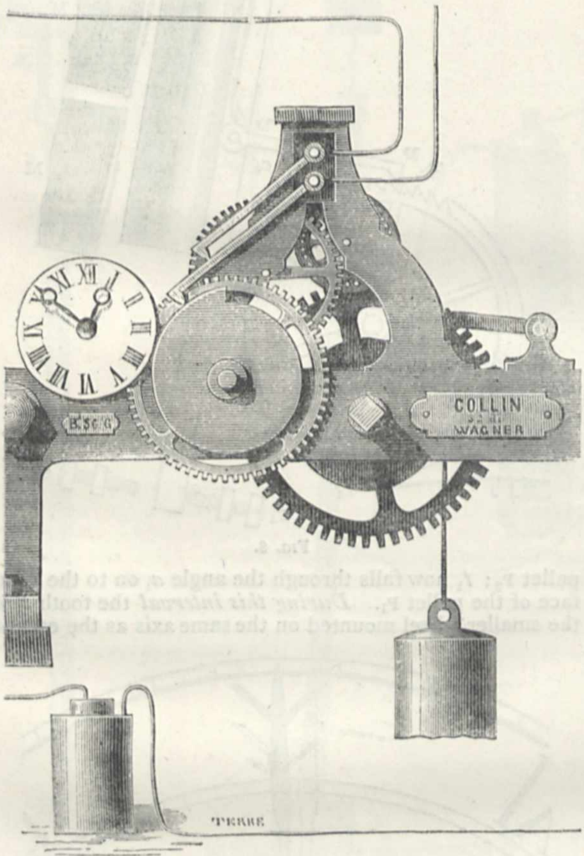

FIG. 10.

It has become popular of late to set the hands of indifferent clocks by electricity. This plan was proposed by Mr. Bain as far back as 1843, and his method of accomplishing it was as follows (see Fig. 9). Behind the minute hand at 12 o'clock is placed a V, and in the minute hand is a pin. Every hour a current from the standard clock raises the V. Should the hand be fast or slow it is immediately forced to the hour, for the pin is bound to find its position at the bottom of the V. A plan similar in operation has recently been patented by Messrs. Barraud and Lund. It is fully described in NATURE, vol. xix. p. 55.

Another method of correcting clocks was invented by M. Collin, Chevalier of the Legion of Honour, and has been largely made use of by him. Fig. 10 shows his standard clock, and Fig. 11 the clock to be corrected; the latter is regulated to gain a second or two per hour. A few minutes before each hour the lower of the two detents in Fig. 10 is lifted against the upper, and a current passes. As regards the clock, Fig. 11, the current avoids

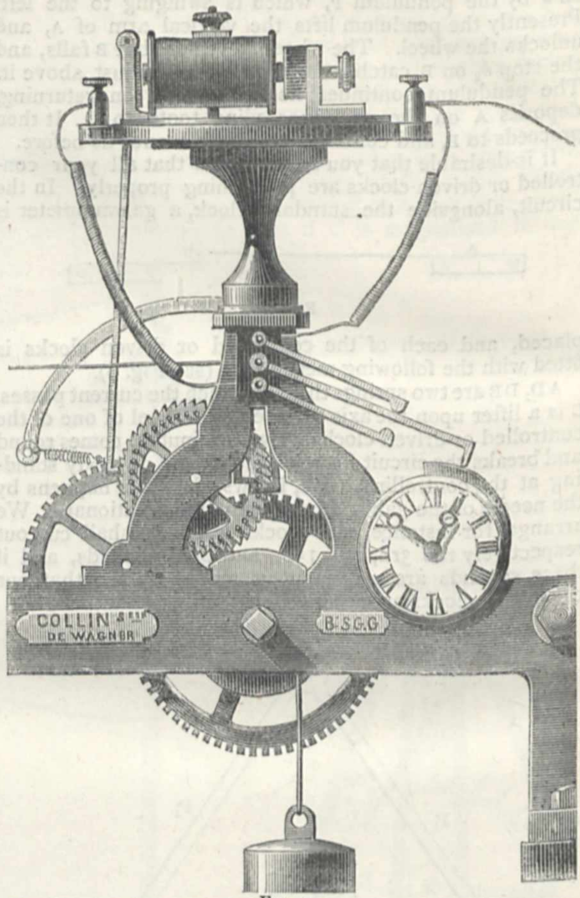

FIG. 11

for the present the coil mounted on the top of it. When

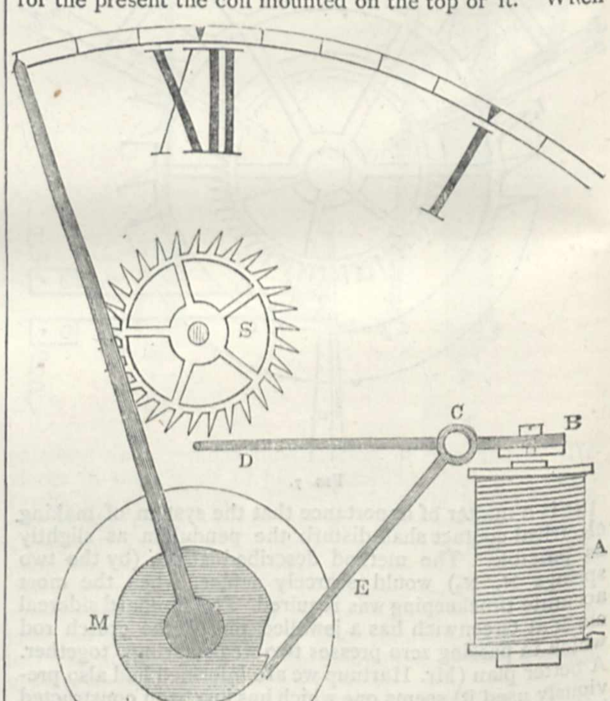

FIG. 12.

the clock, Fig. 11, reaches the hour, it allows the long detent shown in the drawing to fall; this closes the circuit, and a hook attracted by the coil, catches a tooth cut in the escape-wheel, and holds it till the standard clock reaches the hour. At the hour the standard clock, Fig. 10, allows the lower detent to fall, and so breaks the circuit. Consequently the clock, Fig. 11, starts off side by side with the standard.

Mr. Ritchie, to whom we have referred before, has also devised a plan for correcting clocks by hourly currents. His clock, to be corrected in like manner, gains some second or two per hour. Fifteen seconds before each hour the lever D B (see Fig. 12) is attracted by the electro-magnet A, and a pin in the arm D would thereupon enter and catch a tooth of the escape-wheel, did the disc M allow the other arm of the lever E to move. When the hand reaches the hour, E falls, then D catches S and holds it till the cessation of the current at the sixtieth second of the governing clock.

Generally the use of a long telegraphic wire can only be commanded for a few minutes daily. Fig. 13 shows a very suitable arrangement to be adopted when this is the case. By means of the 24-hour disc the line wire is held in communication with the telegraph office until a

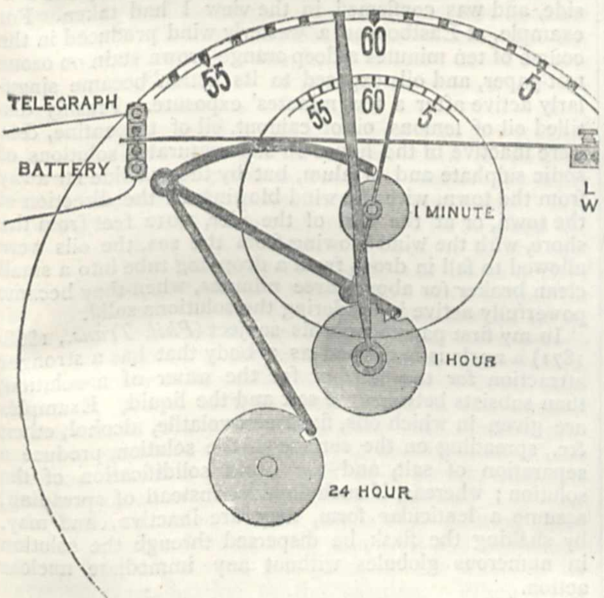

FIG. 13.

few minutes before the clock current is going to be despatched. The notch in the 24-hour disc will at last allow the system of levers to fall, but then the 1-hour disc supports them until about one minute before the clock current is coming; so that, till then, the line is being used for messages. The line wire has not been allowed to fall into circuit with the battery wire; this is still prevented by the 1-minute disc. At the sixtieth second precisely the 1-minute disc allows the line wire to join the battery wire, and out goes the clock current. Some seconds afterwards the 1-hour disc lifts the line wire back into communication with the telegraph office, where it stays for another twenty-four hours.

The Great Westminster Clock reports its own time to Greenwich by the following arrangement:—Some minutes before a signal is due, a lever is lifted by a slow wheel into such a position that a pin in the next wheel at its coming rotation will catch it. The second wheel lifts it so much further that a pin in the escape wheel reaches it, presses two slight springs together, and sends off the signal.

A method of driving an electric dial was contrived by the late E. J. Dent. A powerful magnet was lifted through a coil of insulated wire by a strong tower clock movement. Every half minute the magnet was dropped a current was generated in the coil, which proceeded to the dial and moved the hands. A plan on the same principle has lately been used for driving a number of small dials. A pendulum having a hollow coil of insulated wire for a bob, is by a heavy weight kept oscillating over a system of magnets. Currents are generated in the coil which proceed to the dials and work them.

Only the principal inventions in electrical clocks and clock-work have been indicated in this article. Since the year 1843 upwards of thirty patents have been applied for for improvements in such clocks and clockwork. It will be seen from this the subject, though not a wide one, is extensive.

Mr. Ritchie kindly lent diagrams 5, 6, 9, 12, and 13 to illustrate his plans, and M. Collin 10 and 11. Figs. 1 and 3 have been arranged to exhibit their working with clearness.

HENRY DENT GARDNER

TAUNTON COLLEGE SCHOOL

WE are sorry to chronicle the extinction of a school once watched with interest by all supporters of scientific education. The company which formed it is insolvent; the school buildings with the fine library and all the collections and apparatus which the late head-master amassed will be sold for the benefit of the creditors; the shareholders will lose their money; and the town will fall back for its higher education on the old, dilapidated, unhealthy grammar school.

The directors of the company, who constituted the council of the school, have performed no ordinary feat. Four years ago the school was nearly full, its annual profits considerable, its distinctions, and consequent reputation, unprecedented in so young an institution; public lectures in literature and science attracted to its hall large classes from the town and neighbourhood; and its systematic teaching of science to all its pupils was studied and imitated by many other schools. The council exhibited sudden activity; they starved the teaching-staff, interfered with the discipline and management, thwarted, harassed, humiliated the head-master. Warnings from parents and old pupils fell upon them unheeded. The last term of 1877 saw two open scholarships at Oxford, two places in Cooper's Hill, and a host of minor honours gained by the boys; but it saw also the head-master bullied into resignation, and all but a handful of the pupils withdrawn by their indignant friends. The fate of the school was clear to all except the council; it has lingered on only to add to the liabilities of the share holders, who have now met to learn from their directors the history of a great scheme blighted, of insolvency far beyond the value of the mortgaged property, of their ancient school relapsed into the feeble, obsolete, provincial position from which Mr. Tuckwell rescued it.

ON SUPERSATURATION

A SOLUTION is a case of adhesion overcoming cohesion; and when these two forces are in equilibrium the solution is said to be *saturated*.

In general the adhesive force is diminished by lowering the temperature, and a portion of the solid, a salt, for example, is thrown down; but it is increased by raising the temperature, so that the liquid can take up an additional portion of the solid.

In the case of a large number of salts, but for the most part those that are hydrated, a solution saturated at a given high temperature can be reduced to a lower one without depositing any salt, in which case the solution is said to be *supersaturated*, because it contains more salt than it can take up at the reduced temperature.

For example, 100 parts of water at 194° F. will take up 209 parts of potash alum, but at 32° only 4 parts. A boiling solution of alum containing 209 parts of the salt in 100 of water may be reduced, in a covered vessel, to the freezing-point of water without depositing any salt; in such case the water at 32° holds 52¼ times more salt in solution than it can take up at that reduced temperature.

The phenomena of supersaturation are, perhaps, best exhibited by means of Glauber's salt, or sodic sulphate, of which there are three forms, namely, the normal salt, containing ten atoms or proportionals of water of crystallisation, the seven-atom salt and the anhydrous. If two or three ounces of the normal salt in one ounce of water be gradually heated in a flask to 93° F., its point of maximum solubility, it will be completely dissolved, but if the heat be applied too suddenly or too fiercely, the anhydrous salt is thrown down, and occasions violent bumpings of the vessel. If the solution be properly conducted, it can be raised to the boiling-point, and so be left to cool (the mouth of the flask being covered) to the temperature of the air, without depositing any salt. It is now supersaturated. If, however, the solution be cooled to about 40° F. and under, the modified seven-watered salt is thrown down, the mother-liquor remaining supersaturated. If the flask be left uncovered, or the solution be touched with a proper nucleus, radiating lines, or rather plates of crystals of the normal salt, diverge from a point on the surface, and proceeding rapidly downwards, seem to interpenetrate the seven-watered salt, destroying its transparency, changing its molecular structure, whereby it assumes the appearance of boiled white of egg, and imparting to it three additional equivalents of water. The solution has now become solid, and the temperature considerably raised in consequence of change of state.

The condition of supersaturation was first noticed by Dr. Black towards the end of the last century, and from that time to the present many scientific men, both of this country and of the Continent of Europe, have studied the subject, often with contradictory results. The phenomena connected with the nuclear action of bodies in producing the sudden crystallisation of these solutions seem to behave differently in the hands of different inquirers; so that the facts affirmed by one writer are denied by another; and the theory which seems to have been disproved by one is again brought forward by another. Thus, to quote only a few of these contradictory statements, Ziz found that air and solids act best as nuclei when dry; if wet, or boiled with the solution or thrown into it while hot and allowed to cool with it, they are inactive: Löwel denies that air has any nuclear action, but that solids exposed to the air become active by a sort of catalytic force, and that alcohol is active: Liversidge and others deny that alcohol is active: Selmi states that dry air is nuclear, and acts by getting rid of water at the surface and producing crystals which continue the action: Gay-Lussac had before expressed a similar opinion: Lieben found that soot, platinum black, and pounded glass are nuclei: Schröder remarks that it is always a matter of chance whether such or such a substance produces crystallisation; Gernez, Viollette, Schiff, and Liversidge are satisfied that there is only one nucleus, and that is a salt of the same kind as the one in solution or isomeric therewith; and that when liquid and solid bodies apparently act as nuclei they are really contaminated with minute particles of the salt which is supposed to be always floating in the air: Jeannel opposes this theory, and Pellogio "gives proofs that the phenomena of supersaturation are not so simple as the French physicists would imply;" he finds that porous bodies act as nuclei: Viollette and Liversidge, on the contrary, find that porous bodies and bodies greedy of water and capable of being hydrated, such as absolute alcohol, fused sulphate of copper, quicklime, &c., are quite inactive.

In the midst of all this conflict of testimony, my own results were not likely to escape censure. Indeed, they have been attacked with a degree of acrimony which seems to be very much out of place in the calm inquiry after scientific truth, and in the presence of so many contradictory results produced by eminent conscientious observers. I was not able for a long time to account for the negative results which were opposed to my positive ones, and I threw the subject aside. At length, however, I was led to suspect that nuclei are powerfully affected by varying atmospheric conditions, whereby they sometimes determine the solidification of these solutions, and at other times not. Accordingly I undertook a series of daily observations which extended over some months, working with a standard solution of sodic sulphate and an essential oil, and the result was that when the wind at Highgate was northerly or easterly, the oil was nuclear, but with a westerly or southerly wind it was inactive. It was obvious, then, that there was some force present in the air which rendered the oil active, which being absent, the same oil remained passive. I succeeded in identifying this force with ozone, and judging that wherever ozone was present, irrespective of the direction of the wind, the oil would become nuclear, I visited several places, notably one by the sea-side, and was confirmed in the view I had taken. For example, at Eastbourne a westerly wind produced in the course of ten minutes a deep orange brown stain on ozone test-paper, and oils exposed to its action became singularly active after a few minutes' exposure. Freshly distilled oil of lemons, oil of cajuput, oil of turpentine, &c., were inactive in the house on supersaturated solutions of sodic sulphate and of alum, but by the sea-side far away from the town, with the wind blowing in the direction of the town, or at the end of the pier, 1,012 feet from the shore, with the wind blowing from the sea, the oils were allowed to fall in drops from a dropping tube into a small clean beaker for about three minutes, when they became powerfully active in rendering the solutions solid.

In my first papers on this subject (*Phil. Trans.*, 1868-1871) a nucleus is defined as a body that has a stronger attraction for the salt, or for the water of a solution, than subsists between the salt and the liquid. Examples are given in which oils, fixed and volatile, alcohol, ether, &c., spreading on the surface of the solution, produce a separation of salt, and the rapid solidification of the solution; whereas, if such liquids, instead of spreading, assume a lenticular form, they are inactive, and may, by shaking the flask, be dispersed through the solution in numerous globules without any immediate nuclear action.

Several circumstances favour the action of these liquids as nuclei: (1) Chemically clean flasks and solutions, so as to maintain (2) the surface tension of the solutions as high as possible, in order to spread a drop of oil, &c., into a film; (3) bright and clear weather, with strong evaporative force.

A newly distilled essential oil is inactive, on account of its strong cohesive force, and when a drop of it is dispersed in globules through the solution, each globule retains its surface-tension, whereby it is prevented from coming into contact with, and separating a molecule of the salt held in solution. The action of ozone is an oxidising one, diminishing the cohesive force among the particles of the oil, just as rust weakens the cohesive force of a bar of iron.

The effect which ozone produces quickly on a newly distilled volatile oil, is produced slowly on the same oil by long keeping. Its cohesive force is so far weakened, that a drop of it on the surface of the solution no longer tends to assume the lenticular form, or to disperse in globules through the solution. Then, as oil can adhere much more strongly to salt than to water, and the supersaturated solution being a highly charged system capable of yielding to a force that is exerted in the right direction, such an oil adheres to and separates a molecule of the salt, and the action once begun is rapidly propagated, until the whole solution is solid.

In like manner newly refined fixed oils may have their cohesive force degraded by various chemical means, as by being treated with an alkali, or with nitric acid, &c., in which condition they are commonly nuclear. Solid and semi-solid fats, such as suet, dripping, lard, butter, fat of meat, &c., act powerfully as nuclei. The freshly cut surface acts most effectually, and, in some cases, a fat cut in one direction may not act for hours, while if cut in another direction it may act immediately. A glass rod smeared with lard, &c., may act better than a small lump of the material.

Several observers, who deny that the oils, &c., have any nuclear action, so contrived their experiments as to expose the oils, &c., to the action of heat, while carefully excluding the outer air. The effect of such manipulation is to increase the cohesive force of the bodies in question; and as they fail to act under such conditions, it was denied that they ever acted at all under other conditions, except when contaminated with particles of the salt more or less ultra-microscopic.

So also in testing the nuclear action of porous and dehydrating bodies, heat is employed, and this destroys the very activity which is about to be tested. Freshly ignited quicklime, for example, is inclosed in thin glass bulbs, sealed, heated to redness, and dropped into the supersaturated solutions. When cold, the bulb is broken, and the contents set free, but in no case with any result.

I have found that porous bodies, such as pumice, plaster of Paris, &c., may be rendered inactive by being treated for about ten minutes in a test tube plunged into boiling water. But when such bodies are thrown into the solutions without any separation of salt, it is not that exposure to heat has rendered them less active as nuclei; they have become in fact more active than before, for they now absorb the solution as a whole instead of its water only; whereas, if after being heated, these porous bodies are exposed to the outer air during ten minutes, they take in a little moisture which tames down their absorptive power, so that when placed in the solution they act more slowly, absorbing water and thereby producing a separation of salt and the solidification of the solution. Absolute alcohol acts in a similar manner. Crumb of bread is a very good porous nucleus.

As to the condition of sodic sulphate in solution there are many reasons for supposing that it is the anhydrous salt; that is, the normal salt gives up the whole of its water of crystallisation to the solution. When by a reduction of temperature a portion of the salt is separated, it combines with seven atoms of water, and this is not nuclear. So also when nuclei fail to effect the solidification of the solution, they cannot be said to be inactive, since they act within certain limits of temperature by throwing down the modified salt. But when nuclei are active in determining solidification they form a kind of *point d'appui*, which enables the disengaged molecule to combine with ten atoms of water, and this is nuclear to the rest of the solution and determines its solidification.

The state of supersaturation is dependent to a considerable extent on the adhesion of the solution to the walls of the vessel. If a portion of this be detached by rubbing or scratching the side below the surface with a strong clean wire the whole system breaks down and the solution immediately becomes solid. If the vessel, such as a test tube, be lined with resin, amber, or some substance to which the solution has a weaker adhesion, it generally becomes solid in cooling. Or if a highly supersaturated solution be poured boiling hot into a shallow vessel, in which the surface of adhesion and the free surface are nearly equal, the solution relieves itself by throwing down a considerable quantity of the modified salt, at temperatures above that at which it is usually formed in narrower and deeper vessels.

I have thus very briefly stated the results of my researches on this difficult subject, and submit them to the candid judgment of fellow-labourers in the same field.

C. TOMLINSON

OUR ASTRONOMICAL COLUMN

VENUS IN THE PLEIADES.—A thousand years ago and later the geocentric track of the planet Venus was occasionally such as to cause it to traverse the Pleiades, a phenomenon which, in these telescopic days, would be one of no small interest to the observer; prior to the invention of the telescope its effect would be merely to obliterate in a great measure, for the time being, the stars forming this group, particularly when the planet happened to be upon them near an epoch of greatest brilliancy. Amongst the observations collected from the Chinese annals and forwarded to Europe in the middle of the last century by the French Jesuit, Gaubil, we find one made under the dynasty *Tang*, in the fifth year of the period *Hwuy-Chang*, on the day *Jin-Woo*, of the second moon —corresponding in the Julian Calender to A.D. 845, March 16—when "Venus eclipsed the Pleiades;" the observation appears to have been made at *Si-gan-fou*, where the *Tang* dynasty had their court, and where the earliest occultation of a star or planet by the moon, that of Mars B.C. 69, February 14, was also observed. If we found an examination of this "eclipse" of the Pleiades by Venus, upon Leverrier's data, using them with a sufficient degree of approximation for the purpose in view, it appears that at dusk at *Si-gan-fou*, on March 16, 845, Venus was situate near the star *Electra*, not far from the parallel of the principal star of the group *Alcyone*, but three-quarters of a degree to the west of it, and that about the same time on the evening of March 17, after having passed close to *Maia*, the planet would be in the same right ascension as *Alcyone*, about twenty-four minutes to the north. Although the so-called eclipse of the Pleiades might commence therefore on March 16 as the Chinese record, Venus would be more centrally upon the group on March 17, according to our modern tables. Her apparent diameter was then thirty seconds, and she would shine with more than average brilliancy. Another eclipse of the Pleiades is mentioned under the later *Sung* dynasty, on March 10, A.D. 1002.

VARRO'S STORY OF THE ANOMALOUS TRACK AND FIGURE OF VENUS.—In a *résumé* of the recent progress of astronomy contributed to an American work by Prof. Holden, of Washington, we note a reference to a communication made by M. Boutigny to the Academy of Sciences at Paris in December, 1877, calling attention to a passage in Varro, which describes the planet Venus, as having about the year B.C. 1831 (not B.C. 31, as misprinted in Prof. Holden's Report) "changed its diameter, colour, figure, and course." M. Boutigny had probably overlooked the circumstance that this story of Varro's had been brought into notice long before, in a French work of astronomical authority, the "Cometographie" of Pingré, who, believing that the fable was originated by some celestial phenomenon, considered it was most probably due to the appearance of a bright comet. Pingré thus gives the fragment, preserved by St. Augustin:—"There was seen, says Varro, a surprising prodigy in the heavens, with regard to the brilliant star Venus, which Plautus and Homer call, each in his own language—the evening star. Castor affirms that this fine star changed its colour, size, figure, and track, which had never occurred before, and which has not occurred since. Adrastus, of Cyzicus, and Dion the Neapolitan, refer this great prodigy to the reign of Ogyges." Pingré's explanation will be found in "Cometographie," t. i. p. 247; the epoch he assigns for the phenomenon is "vers 1770."

The story has no astronomical importance, and is only noticed here from its revival so recently, as mentioned above.

NOTES

THE death is announced, at a venerable age, of Sir Thomas Maclear, F.R.S., formerly Astronomer-Royal at the Cape. We hope to be able to give a brief notice of his life and work in our next number.

AT a recent meeting of the Local Committee of the British Association Mr. Harold Thomas and Mr. W. K. Marples, the secretaries of the special committee for arranging the excursions, gave explanations concerning the proposed visits to twenty different places of interest in the district, including Chatsworth, Wentworth, Castleton, Cresswell Crags, Roche Abbey, Sandbeck, Welbeck, Thoresby, Matlock, Arbelow, Stanton-in-the-Peak, Conisborough, Haddon, Hardwick Hall, Bolsover, Wharncliffe, Stainborough, Beauchieff Abbey and Beauchieff Hall, Wingfield Manor, Bradfield, &c. At Arbelow, Sir John Lubbock is to give a lecture on the Druidical remains, which are a source of so much interest to antiquarians visiting that quarter. It was stated that Prof. E. Ray Lankester, F.R.S., had been appointed by the Association to take the place of the Rev. Mr. Dallinger, who is ill, as one of the lecturers for the meetings, and will deliver his lecture at the Albert Hall at 8.30 on Monday evening, August 25, his subject being "Degeneration." Among those who have already signified their intention of being present are Major Serpa Pinto, M. Daubrée, President of the Academy of Sciences, Paris; Prof. Zirkel, Professor of Geology, &c., Leipzig. There have also accepted the invitation to the Sheffield meeting the following, amongst others:—L'Abbé Renard, Keeper of Minerals of Royal Museum, Brussels; Prof. H. A. Newton, Yale College, N.H.; Dr. Wüllner and Madame Wüllner; Dr. Janssen, M. Veth, Leyden, Holland (a traveller in Sumatra); Lieut. Wyse, of the French Navy, and Madame Wyse.

IF any of our readers are within hail of Baden-Baden about the middle of September, they should not fail to pay it a visit some time between the 18th and 24th. The German "Naturforscher," we are sure, will give them a genuine welcome, and they will get a lesson worth learning of how an association of many hundreds from the cream of German science can as a united body combine the severest work with play so hearty as almost to approach "high jinks." In sections and out of sections the German *savants* meet as a body, work as a body, and enjoy themselves as a body. On the morning of September 18, for example, you can listen to Prof. Hermann, of Zurich, lecturing on the acquisitions of physiology in the last forty years, or to Prof. Hirschfeld, of Dresden, on mimic movements of the countenance from a Darwinian point of view, and in the afternoon listen to the military band at the foot of the old castle, finishing off at the theatre in the evening. On Saturday Dr. Nachtigal is to lecture, while the evening is to be devoted to dancing. Sunday is the great day for excursions, while Monday and Tuesday are devoted to sectional work, with fireworks, theatre, and concerts in the evenings. The session finishes on September 24, with, among other things, a lecture on food adulteration, by Dr. Skalweit, of Hanover.

THE biennial meeting of the International Astronomische Gesellschaft will take place at Berlin on September 5-8 next. Prof. Förster, director of the Royal Observatory, will, on application, give more detailed information.

IMMEDIATELY after the meeting of the German Association at Baden-Baden on September 14-24, the German Geological Society will hold its general meeting at the same place, viz., on September 25-28.

THE forty-seventh annual meeting of the British Medical Association was opened at Cork on Tuesday, Prof. O'Connor, of Queen's College, Cork, being president.

THE Cameron Prize, recently founded in Edinburgh University by the late Dr. A. R. Cameron, of New South Wales, "for the most important addition to Practical Therapeutics in the past year," has been awarded to Dr. Paul Bert, Professor in the Faculty of Sciences, Paris, for his researches extending over a series of years and summarised in his work entitled "La Pression Barométrique; Recherches de Physiologie Expérimentale" (Paris, 1878).

MR. TEGETMEIER, we understand, lends his aid as regards press-work of the reprints to be issued by the newly established Willughby Society, which could not have a more efficient director, as the fidelity of his reproduction of Moore's *Columbarium* and Boddaert's *Table* is enough to prove.

ON the morning of Sunday, August 3, a little before two o'clock A.M., the Royal Gardens at Kew were devastated by a hailstorm, which in the space of about ten minutes inflicted more damage than the Gardens have sustained since their existence as a national institution. After a rapid survey of the houses the following day, it was found that the number of broken squares of glass could not be estimated at less than 16,000. In the great temperate house alone 3,000 squares were shattered. The storm, which was accompanied by violent thunder and lightning, drove over the gardens from the north-east, and expended its greatest fury in the direction of Richmond. The temperate house suffered the full effects, while the palm house being apparently a little to the west of its course, escaped with the destruction of 700 panes. The hailstones were found to average one and a half inches in diameter, and to weigh three-quarters of an ounce. They came down with sufficient force to bury themselves in the bare earth of the flower borders, and even penetrate the turf to the depth of an inch. In some cases perfectly circular holes were cut out of the glass panes, while the hailstones went through the succulent leaves of the Echeverias planted out in the beds with as clean an outline as if it had been made with a punch. On account of the confusion produced by the damage and the danger from falling splinters of glass, it has been necessary to close all the houses to the public. The present low night-temperature, and the probability of heavy showers, are grounds for the gravest anxiety as to the preservation of the collections which, however speedy the repairs of the houses, cannot fail to suffer considerable injury. The damage is estimated at not less than 2,000*l*., as many of the houses being a good deal dilapidated, cannot be put in order without entire re-glazing, re-painting, and partial renewal, and application will have to be made to Parliament for a supplementary vote to defray the cost.

WHILE the Abbé Moigno will continue to edit *Les Mondes*, the proprietorship has been converted, he informs us, in the last number, into a sort of joint-stock company, thereby relieving him of all responsibility, and leaving him all his energy to carry on his scientifico-religious propaganda.

WE learn that the late member of the St. Petersburg Academy, Prof. Brandt, has left a mass of MSS. of great value. Among this are two important works which he has left unfinished; one on the contributions made by the St. Petersburg Academy for the advance of zoology, and a synopsis of the fauna of Russia. The MSS. will be published by the numerous friends the late Professor has left in the Academy, and by his son.

THE Royal Academy of Sciences at Munich has elected the following gentlemen as Corresponding Members of its physico-mathematical class:—Prof. Edm. Hébert (Paris), Prof. J. F. Pfaff (Erlangen), Prof. Theod. von Oppolzer (Vienna), Prof.

Ant. de Bary (Strassburg), Dr. N. Pringsheim (Berlin), and Prof. O. E. Meyer (Breslau). Dr. Felix Klein of Munich has been elected as Extraordinary Member.

THE first congress of all the German societies for the protection of animals will be held at Gotha on August 17–19 next.

THE Imperial "Leopoldino-Carolinische" German Academy of Naturalists has presented the well-known Göttingen professor of physics, Dr. Wilh. Ed. Weber, formerly one of Gauss's collaborateurs, with the Cothenius medal, in recognition of his valuable services for the furtherance and progress of experimental physics.

THE following is the prize theme given by the physico-mathematical class of the Royal Academy of Sciences of Berlin:—According to Faraday's theory of electrodynamics, as worked out mathematically by Prof. Clerk Maxwell, the generation and disappearance of dielectric polarisation in isolating media as well as in celestial space, are phenomena which possess the electrodynamical effect of electric currents, and which can be called forth like the latter by electrodynamical induction forces. The currents in question would, according to the theory, be equal in intensity to that one which charges the boundary surfaces of the conductors electrically. The Academy now demands that decisive experimental proofs be given for or against the existence of electrodynamical effects of nascent or disappearing di-electric polarisation, of the intensity supposed by Prof. Maxwell, or for or against the generating of di-electric polarisation in isolating media by means of electromotoric forces induced magnetically or electrodynamically. The term for sending in solutions of the theme ends on March 1, 1882.

ON the 1st inst. a century had passed since the birth of the celebrated naturalist and philosopher, Lorenz Oken (properly Ockenfuss). Oken was born on August 1, 1779, at Bohlsbach, in Swabia, and died on August 11, 1851, at Zurich. He had held for many years the post of professor of natural history at Jena, Munich, and Zurich. His principal works are the well-known "Lehrbuch der Naturgeschichte" and "Allgemeine Naturgeschichte für alle Stände."

RUSSIAN newspapers announce, as we stated last week, that a very rich archæological find has been made by M. Kibalchich, in Southern Russia, on the banks of the Trubesh River, in the Government of Poltava. In a locality covered with numerous small mounds, a sheet of earth with pieces of coal, bones, broken pieces of earthenware, as well as stone and bronze implements, were discovered under the recent sands. The number of stone arrows and knives discovered is no less than 372; besides, M. Kibalchich has found two larger stone implements which were used for breaking great bones, several clay and glass ornaments, earthenware with ornaments, and five bronze arrows. This find is the first in Southern Russia, whilst, as is known, the remains of the stone and bronze periods are very numerous in Northern and Eastern Russia.

A CAPTIVE balloon has been established in Berlin, and was inaugurated on July 27. But the wind having blown with some velocity, the balloon was opened, and the occupants of the car were precipitated to the ground. A tree having diminished the shock, the travellers escaped almost unhurt. The Berlin balloon was about $\frac{1}{24}$ the size of the Paris balloon, inflated with coal gas, and the cover ordinary silk. The *Norddeutsche Zeitung* asks for police inspection before new ascents be made. The intended height was only 500 feet, and the number of passengers two or three.

ON August 30 M. Gaston Tissandier made an ascent from La Villette Gas Works with his wife and his brother. The travellers started at 5h. and landed at 7h. 50 at Dawmartin. The observations were highly interesting. When the *National* left ground, the wind was blowing south-westerly, but at about 7h. the direction changed abruptly, and an instantaneous change took place in the direction of the balloon. It was caused by the *brise de mer* setting in after a hot day. The sky was covered with cumulus, intermixed with a few cirrus of small dimensions. When at an altitude of 600 metres, M. Tissandier passed through a cloud which was very cold indeed, as proved by the sensation which the travellers experienced, but the duration of the passage was so short that it was not possible to observe the temperature at the thermometer. When at a higher altitude M. Tissandier observed the refraction of the rays of the sun on icy particles, and at the same moment on the western sky splendid rainbows. At the same time a very large halo had been observed at Paris by the *Temps* meteorological editor, and noted by him.

DR. DUNANT publishes in the *Journal de Genève* a note on the low temperature of this summer. While the mean temperature for the years 1873 to 1878 was 18°·9 Celsius in June, and 21°·0 during the first half of July, in 1879 it was only 18°·8 and 16°·7.

THE Ramon Société of Toulouse is organising an ascent on the Pic du Midi, to inspect General Nansouty's Observatory. The peak is covered with unseasonable snow, but it will not prevent the ascent from taking place, it is expected, without any great difficulty.

A SHOCK of earthquake was felt on July 20 at 3·30 A.M. at Vulpera, in the Engadine (Switzerland). It was accompanied by a rather strong rumbling.

AN earthquake consisting of three moderately violent shocks is reported from Cairo. The phenomenon was observed in the night of July 11-12. In the quarter of Bab-en-Nasr, which is at some distance from the modern portion of the city, some isolated walls fell in, and an old and somewhat dilapidated minaret has suffered so severely that it must be taken down. During the last decades earthquakes have been extremely rare at Cairo and indeed in Egypt generally, and since the great earthquake of 1857, which caused so much damage amongst the shaky old buildings, in which the Caliph-city abounds, and through which several lives were lost, no earthquake of importance has occurred. The phenomenon of July 11-12 is said to have been noticed also at Gizeh, near the great pyramids.

THE Manila papers state that a terrible thunderstorm passed over that city on May 31. It was preceded by an almost suffocating warm atmosphere and rain, and lasted about an hour. The lightning struck the Binondo Tower, damaging the crystal shade of the clock, but not injuring the mechanism, though the stone work forming the arch was much damaged. Out of several persons in the tower at the time, four appear to have been killed. Several other places in the city were more or less injured.

WE have received from Mr. Henry Chichester Hart, B.A., a copy of his collected papers "On the Flora of North-West Donegal," which have been appearing in the *Journal of Botany*. These floras of particular districts are valuable contributions to a perfect knowledge of the British flora in general, for it is evident that a more thorough exploration of a given range can be better effected by confining the observation to a small circuit than by extending them almost indefinitely. Many points of interest in the localities of species are more clearly indicated by these contributions than we expect to find in a work which treats of the flora of the entire country. As an illustration of the utility of these papers we may refer to the fact that *Ophioglossum lusitanicum*, L., was found by Mr. Hart in August last amongst short grass near the margin of a cliff on the northern side of

Horn Head; the fronds were fertile at the time notwithstanding that the plant has been usually quoted as flowering in January. Mr. Hart further points out that the claims of this fern to a place in the British flora have hitherto rested upon its known habitat in Guernsey.

In the June number of *The California Horticulturist*, amongst other articles of horticultural and local interest, is one on the Sierra Forests, pointing out the great risk there is of these magnificent forests becoming denuded as they "are now and for many years have been, at the mercy of private greed and public theft." The writer says it is true no changes are yet manifest, there are miles of forest left, and ravines wherein no chopper's axe has yet resounded. It is not the axe that is feared but the sheep and cattle owned by private individuals that have for years been pastured on the Government lands of the Sierras. The common practice, it is said, has been for a man having perhaps five or ten thousand head of sheep to purchase one single quarter section from the Government to build his house on, and perhaps to hold the best springs of water. From that central point his flocks and herds roam for miles, under the spicy pines and cedars, trampling the soft rich ground until it is like iron, destroying every seed, killing all the young trees, and causing the State a yearly loss in the value of her forests, which is far more than the worth of the whole band of sheep. The article concludes with a reference to the matter having occupied the attention of some of "our best thinkers." "Prof. Sargent, of Harvard," we are told, "points out in the *Nation* the disastrous effects of such a policy; Prof. Hooker, of Kew Gardens, follows in the same line of thought; and John Muir mourns over the desiccated forest-shrines, and the rarer flowers and ferns, now rapidly passing out of existence."

Messrs. Longmans and Co. have just issued a little book on "Town and Window Gardening," being the substance of a course of lectures "given out of school hours to pupil teachers and children attending the Leeds Board Schools." These lectures were given by Mrs. C. M. Buckton, a member of the Leeds School Board, and author of two recently published books called respectively "Health in the House," and "Food and Home Cookery." These endeavours of Mrs. Buckton to raise the moral and intellectual welfare of the working classes are highly praiseworthy, and though the book before us may not claim a position amongst standard scientific works, yet there is much that is good scattered through it which cannot fail to raise the tastes of many a child fortunate enough to come under the influence of teachers like the authoress who have a real admiration for nature in all its branches and a heartfelt desire to impart as much knowledge as possible to the children of our crowded alleys.

The Tasmanian gold-fields are reported to be very successful, and some rich finds have occurred on the Pieman River. The locality is about seventy miles across country from the tin deposits at Mount Bischoff. Numbers of people are flocking to the diggings from all quarters.

The additions to the Zoological Society's Gardens during the past week include a Weeper Capuchin (*Cebus capucinus*) from Guiana, presented by Capt. Bond; a Brown Bear (*Ursus arctos*) from Russia, presented by Mr. J. R. Boyce; a Tawny Eagle (*Aquila nævioïdes*) from Southern Spain, presented by the Marquis de la Granja; a Bateleur Eagle (*Helotarsus ecaudatus*) from the Isle de Bas, Sierra Leone, presented by Mr. Alex. Sinclair; two common Crossbills (*Loxia curvirostris*) European, presented by Mr. H. A. Macpherson; a Common Cuckoo (*Cuculus canorus*), British, presented by Miss C. Bealey; a Central American Agouti (*Dasyprocta isthmica*) from Central America; two White-faced Tree Ducks (*Dendrocygna viduata*), a Red-billed Tree Duck (*Dendrocygna autumnalis*) from Rio Magdalena, purchased.

SOUTH CAROLINA FOSSILS

In a paper on "Vertebrate Remains, chiefly from the Phosphate Beds of South Carolina," published in the *Journal* of the Academy of Natural Sciences of Philadelphia (vol. viii. part iii.), Prof. Joseph Leidy prefaces his careful description of the many separate remains by a few general remarks on the subject, some extracts from which may interest our readers. The fossils are mainly from the so-called Ashley phosphate beds of South Carolina, which "are composed of sands and clays, intermingled with irregular porous masses of more coherent rock rich in calcium phosphate, together with many organic remains. These beds, the economical importance of which was fully made known in 1868 by Prof. Francis S. Holmes and Dr. N. A. Pratt, of Charleston, occupy a large extent of country in the southern part of South Carolina, on the Wando, Cooper, Ashley, Stono, Edisto, Coosaw, Asheepo, and other rivers. According to Prof. Holmes, from 'fifteen to eighteen inches may be considered the average thickness of the stratum of the phosphate rocks.'[1]

"The exact stratigraphical relations of the beds and the relative age of these and contiguous strata have not been as thoroughly investigated as is desirable, and in many cases the particular horizon to which belong the fossils that have been discovered has not been positively determined. According to Prof. Holmes, the phosphate beds are of the post-pliocene period and overlie strata pertaining to the pliocene period and these are again succeeded by a soft marl rock of eocene age, the whole being covered by modern alluvium.

"The phosphatic rocks or nodular masses of the phosphate beds, said to contain as high as sixty, or even more, per centum of calcium phosphate, are of irregular shape, and range in size from small pieces up to masses of a thousand pounds or more.[2] They contain many casks of molluscous shells, which appear to be of the same forms as those which occur in the eocene or miocene marl rock beneath. They also frequently contain imbedded bones and teeth, mainly those of marine fishes and cetaceans.

"The phosphatic nodules are supposed to have been derived from the tertiary marl bed beneath, and are considered to be detached and altered fragments from the surface of that bed. The irregular, eroded, and porous masses have the appearance of being detached and water-rolled fragments of the tertiary marl rock after it had been tunnelled by various boring molluscs. It is, indeed, not improbable, as has been suggested, that in the later part of the eocene or miocene period and subsequently the easily penetrated rock was bored and rendered spongy by the incessant labours of multitudes of *Gastrochæna*, *Petricola*, *Pholas*, &c. At the time or later, neighbouring and superficial islets, the resorts of myriads of sea-fowl, may have furnished the material which, when washed with the ocean and mingled together with the decomposing remains of marine animals, supplied the element for the conversion of the porous marl rock into the more valuable phosphatic compound.

"Besides the phosphatic nodules, the Ashley beds present a remarkable intermixture of the remains of marine and terrestrial animals, consisting of bones, teeth, coprolites, shells, &c., derived from the contiguous formations of various ages from the early tertiary to those of a comparatively recent period.

"Of remains of vertebrates, those of fishes and cetaceans prevail, especially the teeth of sharks and the vertebræ of whales. Less frequently there occur the vertebræ and teeth of large teleost fishes, the dental pavements of rays, fragments of turtle shells, vertebræ of crocodiles, ear-bones and teeth of cetaceans, bones of manatees, &c. With these likewise are found the remains of both extinct and still existing terrestrial mammals, especially teeth and bone fragments of elephant and mastodon, megatherium, horse, tapir, bison, and deer. More rarely there are found remains of hipparion, castoroides, hydrochærus, and of the smaller and more common genera of species.

"The fossils mainly consist of the harder parts of the skeleton and of teeth, usually more or less water-worn, indicating shallow seas and an active surf to which they were exposed. Many of them exhibit the drilling effects of boring molluscs, especially those which are supposed to have been derived from the tertiary marl rock, the operation of drilling apparently having been performed both before and during the time the fossils were embedded in the rock. Only enamel or the enamel-like dentinal

1 "The Phosphate Rocks of South Carolina." By Francis S. Holmes, A.M., Charleston, 1870, p. 70.

2 A nodular mass, on exhibition in the government building, from Charleston, S. C., weighs 1,150 pounds.

layer such as is found investing the crown of the teeth of sharks, appears to have been a protection against the drilling power of the borers.

"Fossils excavated from the phosphate beds are of a ferruginous brown colour, but often much lighter or white upon the surface. Those which are obtained from the rivers contiguous to the beds are usually more or less black, with the enamel of teeth iron-gray, and they frequently exhibit the basal attachment of small barnacles, and occasionally the valve of an oyster.

"From the fossils consisting mainly of the harder and denser, and therefore heavier parts of skeletons and teeth, they are generally assumed to be petrified, but usually the change has not been more than a moderate loss of the ostein basis and the infiltration of iron oxyd.

"From the extraordinary variety and profusion of the fossil remains of the Ashley phosphate beds it may be inferred that these were the former rich feeding grounds for multitudes of marine and amphibious animals. At an early period during the formation of the tertiary marl here congregated great sharks, rays, squalodons, &c. At a later period their successors varied their diet with the carcases of great land animals, as elephants, mastodons, &c., which floated down the broad and swollen rivers, as drowned herds of the bison are said to do in our day upon the Missouri River.

"Some of the remains of terrestrial animals, comparatively few in number, found as fossils in the Ashley phosphate beds, including even the softer or more spongey bones, exhibit no evidence of violent water action other than the signs of decay from the combined influence of moisture and air; neither do such fossils exhibit the marks of boring molluscs, nor the attachments of barnacles. Usually black and more or less friable, these fossils, such as the bones of mastodon, megatherium, deer, &c., are no doubt the remains of animals which became mired and sank into marshes of the Ashley phosphate beds after these had become elevated above the surface of the neighbouring sea. Of this nature, also, we may believe, are the remains of more recent animals, including also specimens of human bones, those of domestic animals, and stone implements, which are occasionally found in the Ashley phosphate beds."

SCIENTIFIC SERIALS

American Journal of Science and Arts, July.—Contributions to meteorology, by E. Loomis (eleventh paper).—Silurian formation in Central Virginia, by J. L. Campbell.—New form of spectrometer, and on the distribution of the intensity of light in the spectrum, by J. W. Draper.—Extinct volcanoes about Lake Mono, and their relation to the glacial drift, by J. Leconte. Mineral locality in Fairfield Co., Connecticut, by G. J. Brush and E. L. Dana (third paper).—Note on the progress of experiments for comparing a wave-length with a metre, by C. S. Peirce.—Recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill.—Position of the planets *Philomela* and *Adcona*, by C. H. F. Peters.—Method of preventing the too rapid combustion of the carbons in the electric lamp, by H. W. Wiley.—Bernardinite, a new mineral resin, by J. M. Stillman.—Notice of a new Jurassic mammal, by O. C. Marsh.—On the Hudson River age of the Taconic schists, by James D. Dana.—(Several of these papers are noticed by us elsewhere.)

Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande und Westfalens (Bonn, vol. 35, parts i. and ii., 1878).—From these parts we note the following papers:—Section for Geography, Geology, Mineralogy, and Palæontology: Description of the Cotopaxi and its last eruption on June 26, 1877, by Th. Wolf (with plates).—On the eruptive rocks in the Saar and Moselle districts (with plates), by A. von Lasaulx.—Chemical examination of Westphalian and Rhenish rocks and minerals, by W. von der Marck.—New researches on the oldest Devonian formations of the Harz mountains, by C. Schlüter.—On some spiders and a myriapod from the brown coal of Rott (with plate), by Ph. Bertkau.—On some ferns from the coal flora, by Dr. C. J. Andrä.—On some new Cephalopoda from the North German chalk deposits, by C. Schlüter.—On the geology of Italy, by Herr vom Rath.—On O. Volger's new theory of wells and sources, by Dr. Mohr.—On the depths and configurations of the sea-bottoms, by Herr Fischer.—On the crystallisation of cyanite, by Herr vom Rath.—On the natural conditions of Elberfeld, Barmen, and neighbourhood, by Herr Cornelius.—On the development and importance of coal mining in the Rhineland and Westphalia.—On the geognostical conditions of the Oster Wood near Elberfeld, by Herr Buff.—On the mining operations in the Eifel from a historical point of view, by Herr Voss.—On some fossil bones from the Unkelstein, by Herr Schwarze.—On the perception of the earthquake of August 26, 1878, in the Rhenish mines, by Herr Fabricius.—On a fossil elephant's tusk from Hennef in the Sieg Valley, by Herr Buff.—On a löss-like formation in the diluvium of the Weser district, by R. Wagener.—Botanical Section: Further researches on the fertilisation of flowers by insects, by H. Müller.—On *Limodorum abortivum*, Sw., and *Epipogium gmelini*, Rich., by G. Becker.—On *Ophrys arachnites* and *O. apifera*, by the same.—On some rare specimens from the Rhenish flora, by the same.—On the persistence of flowers and fruits in their position with regard to the horizon, by Herr von Hanstein.—Anatomical and physiological researches on the nectaries of flowers, by Herr Behrens.—On the change of colour in leaves, by Herr Lindemuth.—Section for Anthropology, Zoology, and Anatomy: Herpetological drawings made by Rösel von Rosenhof (from his posthumous papers), discussed by F. Leydig.—On some parasitical hymenoptera, by A. Förster.—On the mollusk fauna of Westphalia, by P. Hesse.—On the clothes of man compared to the natural coats of animals, by Prof. Troschel.—On the whales occurring on the coasts of Japan, by Herr Mohnike.—On the spermatogenesis of mammals, by Prof. von la Valette St. George.—On the differences between *Atypus piceus*, Sulz., and *A. affinis*, Eichw., in the female sex, by Herr Bertkau.—On the bats of the Rhineland and Westphalia. On thirty-six species of fish caught in the Rhine near Linz, by Herr Melsheimer.—Section for Chemistry, Technology, Physics, and Astronomy: On the action of prussic acid, by Herr Wallach.—On normal weights made of rock crystal, by Herr Stein.—On a metallurgical work published in Japan in the seventeenth century, by Dr. Gurlt.—On celluloid, by Dr. Köster.—On the nature of the force of attraction, by Prof. Mohr.—On the decomposition of salicylate of soda by carbonic acid, by Herr Binz.—On Prof. Newcomb's researches on the motion of the moon, by Herr Schönfeld.—On the Rott tunnel near Barmen, by Herr Hövel.—On a universal hand-boring machine for hard rocks, by Herr Faber.

Journal of the Franklin Institute, July.—Power-transmitting mechanism; on the strength of the teeth of wheels, by Mr. Cooper.—Harmonic and basic lines and tendencies, by Dr. Chase.—Committee report on Olsen's testing machine.—Machines for measuring, by Mr. Richards.—The electric arc, its resistance and illuminating power, by Professors Thomson and Houston.—Effects of atmospheric changes on textile bands, by Mr. Woodbury.—Phosphorus in bituminous and anthracite coals, by Mr. Roney.

THE quarterly *Revue des Sciences naturelles* (2nd series, vol. i., No. 1).—On the aphides inhabiting *Pistacia terebinthus* and *P. lentiscus*, by L. Courchet.—Morphological researches on the family of Graminaceæ, by D. A. Godron.—On some plants gathered in the neighbourhood of Montpellier in 1877, by M. Duval Jouve.—Catalogue of the land- and river-molluscs of the Hérault department, by E. Dubrueil.—On the employment of collodion for obtaining microscopical sections, by M. Duval.—Note on the discovery of a layer of limnacidæ-marlstone (shell-marl) at Celleneuve, near Montpellier, by F. Fontannes.—On the reason of the occasional simultaneous occurrence of limestone plants and silica plants, by Ch. Contejean.

THE *Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis zu Dresden* (1878, part ii., July-December) contain the following papers of interest:—On the earthquake observed at Nolhac on July 24, 1878, by J. von Boxberg.—On the tertiary basin of Bilin, by Herr Deichmüller.—On the cones of *Glyptostrobus europæus*, Brongn., by Herr Engelhardt.—On the bed of the River Priessnitz, near Dresden, by the same.—On J. H. Schmick's work: the sun and moon as constructors of the earth's shell, by Clemens König. The reviewer condemns Herr Schmick's theory completely, and draws attention to its numerous weak points.—On the mineralogy and geology of the St. Gotthardt, by Herr Roscher.—On some abnormal cone formations in pines, by Dr. Nobbe.—On some Swedish plants, by Herr von Biedermann.—On some new results in prehistoric research, by Dr. Geinitz, sen.—On a light machine, by Dr. Töpler.—On an elementary derivation of the law of gravitation from Kepler's laws, by Herr Helm.—On an expedition to the Arctic Ocean and the White Sea, by Herr Baldauf.—On silicified roots and other wooden objects found at Oberau, Tessen, and Okrylla, by Dr. H. Conwentz.—On the silicified woods from the diluvium of Kamenz, Saxony, by Dr. E. Geinitz.—On the general conception of space and its applicability in natural research, by Dr. A. Harnack.—On the electrometric appliances of the present day, by Dr. Töpler.

Journal de Physique, July.—On the optical figures of polychroic crystals, by M. Bertin.—On the figures presented by crystals having one optical axis, by M. Bertrand.—Noës' thermo-electric piles, by M. Niaudet.—Colours, the chromometer, and photography of colours, by M. Cros.

Gazetta Chimica Italiana., fasc. iv. and v.—On nicotine, by S. Andreoni.

SOCIETIES AND ACADEMIES

GENEVA

Society of Physics and Natural History, February 6.—M. L. Lossier explained a special method which he has introduced for assays of gold.—M. Albert Rilliet gave an account of a research made by him and M. E. Ador on the hydrocarbons obtained by the action of the chloride of methyl on benzine in presence of chloride of aluminium.

February 20.—M. H. de Saussure described an apterous insect of Gaboon, whose mode of life is unknown, and which has been described under the name of *Hemimerus*. It has the remarkable characteristic of possessing a second lower lip provided with palpi, and several other characteristics make it an insect of an altogether special nature, difficult to classify in any of the known orders.

March 6.—M. Casimir de Candolle has studied the anatomy of the leaves of some cotyledons, and particularly the internal conformation of their petiole, or the principal nervure. This petiole shows in its centre a woody bundle presenting very varied forms—sometimes that of an arc, sometimes that of a complete ring. Besides this complete ring, there are frequently observed woody bundles placed outside the ring, and which M. de Candolle calls cortical; at other times bundles inside the ring, and which M. de Candolle calls intra-medullary.—M. Ph. Plantamour observed during the cyclone of February 20 a notable depression of level of the Lake of Geneva. The wind produced this effect of depression notwithstanding the diminution of atmospheric pressure indicated by the barometer, and which would tend to raise the level of the water. When the wind assumes the form of a whirlwind, it produces an aspiration instead of a depression. The rate of the cyclone referred to appears to have reached at least 24 metres per second.

March 20.—Prof. E. Plantamour presented a quarto volume entitled "Telegraphic delimitation of the difference of longitude between Geneva and Strasburg," published by himself and M. M. Löw. This operation, executed in 1876, resulted in a difference of 6m. 27·934s.—M. D. Colladon, on the occasion of very remarkable cases of *verglas* observed in Paris on January 20 and 23, recalled former cases described by him and others (see *Comptes Rendus*, t. lxxx. viii., March 31, 1879).

April 3.—M. Raoul Pictet communicated the continuation of his researches on the theory of heat. He admits that the amplitude of the oscillations of molecules around their position of equilibrium may be taken as a measure of heat, or as corresponding to the temperature. He explains by this definition the properties of fusibility of metals and the anomalies of Mariotte's law.—Prof. Brun described a curious case of poisoning in a child of two years, resulting from eating a combination of cabbage and figs. The cabbage must have produced a great abundance of lactic acid, which in presence of the glucose of the figs had produced buteric acid in sufficient abundance to cause the death of the child.

April 17.—Prof. Alph. Favre has found iron in the state of particles attractable by the magnet in all the earths and rocks of the country around Geneva which he has examined. This iron, in grains, not being soluble, cannot be considered in the analysis of arable soils, as profitable to vegetation. Hence erroneous conclusions resulting from these analyses, which suppose more iron than there is possible for vegetation. The origin of this iron is attributed in part to the *débris* of meteorites.

PARIS

Academy of Sciences, July 28.—M. Daubrée in the chair.—The following papers were read:—Researches on the refraction of obscure heat (continuation), by M. Desains.—Note on the hydrate of chloral, by M. Wurtz.—Observations on the memoir of MM. Noble and Abel on explosive substances, by M. Berthelot.—On the theory of hail, according to MM. Oltramare and Colladon, by M. Faye. M. Boussingault also made some observations on the subject.—On the effect of electrical excitations applied to the muscular tissue of the heart, by M. Marey.—Memoir on the temperature of the air at the surface of the ground and of the earth to 36 m. depth, as also on the temperature of two soils, one exposed, the other covered with grass, during the year 1878, by MM. Ed. and H. Becquerel.—Researches on samarium, radicle of a new earth extracted from samarskite, by M. Lecoq de Boisbaudran.—MM. Georges Pouchet and S. Jourdain were then nominated candidates for the chair of Comparative Anatomy at the Natural History Museum, vacant through the death of M. Paul Gervais.—M. Daubrée then reported on the experimental researches of M. Stanislas Meunier, relating to the meteoric nickel-iron and native carburetted iron of Greenland.—Two memoirs were presented to the Academy, one by M. David, on the development of algebraic functions, the other by M. Poincaré, on the effect produced by the inhalation of nitrobenzole vapour.—On some observations of planets (198) and (200), made at the Marseilles Observatory, by M. Stephan.—On an application of rational mechanics to the theory of equations, by M. F. Lucas.—On the action of light on electric piles, by M. H. Pellat.—On the refrigerating action of air at high pressure, by M. A. Witz.—On the distillation of a heterogeneous liquid, by L. Troost.—On the quantities of organic matter in mineral waters, by G. Lechartier.—Thermo-chemical researches on the soluble alcaline sulphides, by M. Sabatier.—On the decomposition of sulphide of ammonium, by MM. R. Engel and A. Moitessier.—On the calcination of turnip-molasses, by M. C. Vincent.—On the influence of sugar injected into veins upon the secretion of urine, by MM. Ch. Richet and R. Moutard-Martin.—On the irritability of a muscle during the different periods of its contraction, by M. Richet.—On the discovery of medicaments and poisons in saliva, by M. Gabriel Pouchet.—Comparison of the influence of intravenous injections of chloral, chloroform, and ether, by M. Arloing.—On the lympho-glandular organs and the pancreas of vertebrates, by M. Renaut.—On some multinuclear animal and vegetable proto-organisms, by E. Maupas.—On the two great phases of the annual circulation of the atmosphere, by L. Brauet.—Experiments on milk-production, by M. Lami.—On the formations of the so-called "Dombes," by M. Nivet.—On the palm-wine of Laghouat, by M. Balland.

CONTENTS