THURSDAY, JULY 5, 1877

THE CAXTON EXHIBITION

THE exhibition just opened at South Kensington to commemorate the 400th anniversary of the first authentic publication issued from an English press, is one that must appeal to all who can read, and possesses an interest for the man of science from various points of view. We need not repeat the many platitudes that have been uttered and are now likely to be reiterated on the vast importance of the invention of printing by means of movable types. It was a gift to the people of Europe of a pair of intellectual seven-leagued boots wherewith to tread the path of culture; progress during the last 400 years has been beyond all proportion more rapid than during any previous period, and while no doubt other causes have been at work, the strongest impulse has been received from the invention so interestingly illustrated at South Kensington. Mr. Gladstone, in his speech on Saturday, stated that he did not think the invention of movable types in itself anything very extraordinary, and wondered that it had not been blundered on long before the time of Gutenberg and Fust. But the same might be said of most inventions in their first rude forms; we who are accustomed to locomotive engines and ocean-going steamers, for example, are apt to wonder how the world was so long in hitting on these applications of steam. But the truth is that in art as in nature no stage is reached by a leap; it requires a collocation of many little circumstances before any new form is ripe for development. And probably, if we could minutely trace the precedents of the invention of printing, we might find that it was the most natural thing possible that it should have taken place just when it did and not before. Probably all the material conditions or "environment" may have reached the proper stage a century before the actual invention, but then there was no Gutenberg or Fust (or whoever the genius was, for this is no place to discuss the much-discussed question) with the requisite discernment to perceive this, and the practical skill to proceed in the direction indicated by the conditions. It is curious that all the extant remains of the work of the earliest known printers are really wonderful in beauty of execution, which makes one doubtful if we have any of the very earliest specimens, and whether the date of invention should not be pushed further back than the accepted one.

The exact date of the invention, however, has not been satisfactorily ascertained. That it was complete by the year 1450 there seems no doubt, and by the year 1500 printing-presses had been set up in 220 places in Europe, and many books, mainly editions of the classical writers, and religious books, were in circulation by their means. Mainz was the city in which the new art reached its first full development, spreading thence to Haarlem and Strassburg, from Haarlem to Rome, 1466, by Sweynheym and Pannartz, who are said to have been the first to make use of Roman types, to Paris in 1469, to England about 1474, and to Spain in 1475.

The exact date of the introduction of printing into England is not certain; it may have been 1471, it was not later than 1477, the date of the publication of Caxton's "The Dictes and Sayings of the Philosophers," the first book certainly printed and published in England, at the Almonry at Westminster Abbey, where Caxton set up his press; it is to commemorate this event that this year has been chosen for the Caxton celebration. There is a story that a press was set up at Oxford a few years before Caxton's at Westminster; but the evidence for this statement is quite untrustworthy. The first English book printed was by Caxton at Bruges, probably in the year 1474, "The Recuyell of the Histories of Troye." It was at Bruges, where Caxton lived in his capacity of mercer, a man of great importance, and in the retinue of the Duchess of Burgundy, that he learned the new art of printing from Colard Mansion; when he brought the invention to England he was probably about fifty years of age, having been born in the Weald of Kent somewhere about 1420: nearly all dates connected with Caxton are very uncertain.

According to Oldys, the first book in which Caxton had any hand is one which may very fairly be considered as connected with natural science. Its title was "Bartholomeu de Proprietatibus Rerum," said to have been printed while Caxton was at Bruges in the retinue of the Duchess of Burgundy. The work is a kind of natural history, by Bartholomew Glanvill, a Franciscan friar, who flourished about 1360, explaining more especially the nature and properties of the beasts, birds, fishes, stones, &c., mentioned in Scripture. The work had already been translated into English in 1398 by John de Trevisa, and the translation was printed in England, probably on the first paper made in this country, by Wynkyn de Worde, after Caxton's death. It is only right to state, however that according to Mr. Blades, the great authority on all connected with Caxton, no impression of the edition in which Caxton is said to have had a hand, has ever been found.

Caxton, who died in 1491, although he published from his press at Westminster a wonderfully large and varied collection of works, does not appear to have been attracted to any bearing on science, strictly so called. Probably Mr. Gladstone hit on the reason in his estimate of Caxton's character when he spoke of him as a thoroughly practical Englishman who went in only for what would pay. The "Image or Mirror of the World," one of the popular books Caxton translated from the French, treats, however, of a vast variety of subjects after the imperfect natural philosophy of the day. We have an account of the seven liberal arts; of nature, how she worketh; and how the earth holdeth him right in the middle of the world. We have also much geographical information, amongst which the wonders of the Inde occupy a considerable space. Meteorology and astronomy take up another large portion. The work concludes with an account of the celestial paradise. There are twenty-seven diagrams explanatory of some scientific principles laid down in this book; and eleven other cuts illustrative of other subjects treated in the work. The work was translated by Caxton in 1481, but the first edition has no printer's name, place, or date. The history of the "Mirror of the World" may be summed up thus:—Before the middle of the thirteenth century an unknown author wrote in Latin "Speculum vel Imago Mundi." In

1245 this was turned into French metre by the Duc de Berry; in 1464 this was turned into French prose, and from this text Caxton took his translation.

Even abroad the proportion of scientific to other classes of works issued from the early printing presses was comparatively small; but this may be satisfactorily enough accounted for by the fact that there were then comparatively few really scientific works in existence. From the Italian presses a very large number of arithmetical and geometrical works were issued at the end of the fifteenth and beginning of the sixteenth century. The Alphonsine tables were printed at Venice in 1483; but one of the earliest works in any way connected with science must have been a folio sheet, "Conjunctiones et opposiciones solis et lunæ," dated 1457; the place of publication we have been unable to ascertain. There is a "Gerardis Cremonensis Theoria Planetarum," quarto, dated 1472, and an Albertus Magnus "Opus de Animalibus," printed at Rome in 1478. Other early printed works which, considering the time, may be classed as scientific, are "Questiones Johannis Cunonici super octo libros Physicorum Aristotelis" (Padua, 1475); "Garetani de Thienis in Meteor. libros Aristotelis Expostio" (Padua, 1476); "Prognosticon," a meteorological work published at Venice in 1485. But when we come into the next century the number of strictly scientific works published in England and other European countries increased with amazing rapidity, and we may say has gone on increasing in ever enlarging proportion ever since. The first English translation of Euclid by Billingsby is said to have been published in 1570.

It is a small thing that books of science are all but unrepresented in the Caxton Exhibition; these could no doubt have been obtained had they been sought for; but the object of the exhibition is simply to illustrate the origin and growth of the art of printing, which has been an inestimable boon to science as it has been to every other form of human activity, and the man of science owes as much gratitude to its inventors, and to Caxton its introducer into England, as does the worker in any other department of culture. Happily, as we hope to show, science has been able to some extent to repay her debt by importing improvements into the art which would not have been possible but for her researches.

THE DEVELOPMENT OF THE OVUM

Bütschli on the Earliest Developmental Processes of the Ovum, and on the Conjugation of Infusoria.

Studien über die ersten Entwicklungsvorgänge der Eizelle, die Zelltheilung und die Conjugation der Infusorien. Von O. Bütschli. (Frankfurt, 1876.)

FEW subjects can be more important in their bearing on biology than the more prominent of those considered in this volume. It now rests on a morphological basis which will never be shaken, that there has been a procession of the most complex animal forms from simpler and still simpler ones, until we reach eventually the ultimate of organised simplicity. There may be difficulties in the way, but they are as nothing to the overwhelming evidence which morphology provides in its support; doubt, indeed, is no longer possible; and every year diminishes the circumscribed area of difficulty. But our knowledge hitherto of the developmental processes which take place in the earlier states of the simplest elementary organisms is wholly incompetent. Much labour has been expended, and doubtless good work has been done; but as it at present stands, it is conflicting, crude, and essentially wanting in coincidence and correlation. The work before us is the result of an attempt on the part of its author to penetrate farther into the matter than his predecessors, and by completer knowledge to harmonise or explain away conflicting evidence and doubtful interpretation, and if possible to give a sequence to the morphological processes in the simplest ova, and in the least apparently organised of animal forms.

From the smallness of the space at our disposal all consideration of the second subject discussed in this volume must be passed over. It deals with cell and nucleus fission generally; but as it is chiefly theoretical, we may the more readily omit it, merely remarking that the author concludes that there is a fundamental harmony in the method of fission in the cells of both animals and plants; a conclusion which it may be fair generally to admit; but in the minute detail, only discoverable by prolonged research, there will be found palpable differences.

That which gives distinction, and to some extent importance to the book, is (1) its minute and practical investigation into the earliest changes effected by development in the ova of some of the more lowly organised animal forms; and (2) the abundance of data which it appears to provide for the support of a new theory of propagation amongst the infusoria, which Bütschli propounds and advocates.

The embryological researches under the first head were conducted principally upon the ova of the Nematoid worms and the Rotifers. To a limited extent the living egg was studied; but the greater part of the results are derived from investigations of the ova treated with acetic acid. This is greatly to be regretted. The difficulties which present themselves in the minute examination of such ova in the living condition, are doubtless great, indeed complete results could scarcely be obtained from this alone. But undoubtedly the continuous examination of a set of living ova in process of development should be carried on simultaneously with every method of treatment which will reveal structure and change in ova of the same form in the dead condition. Only in this way can every possible mutation be traced, and its correlation and sequence be established.

It is extremely difficult to distinguish even striking discoveries in this direction from the manifold claims put forward by the many observers. We must state generally the facts as they at present appear, and seek to indicate the points specially claimed as new by Bütschli. It is now well known that the ovum is not suddenly formed, and then stimulated into new activity by fertilisation. It evidently, in its very lowliest condition, goes through a process of internal growth and development; after which apparently it perishes unless fecundated. In 1864 Balbiani endeavoured to prove that besides the *germinal vesicle*, there existed one still more important, which he called the embryogenic cell or vesicle in the ovarian ovum; and it was held by leading embryologists

that it was round this cell that the true embryo was constituted; but in what manner, each observer appears to have determined for himself. The disappearance of what was accepted as the germinal vesicle was generally agreed to; but whether before or after impregnation was never fully determined. That it merely retrograded to the centre and determined segmentation as the result of fecundation, was held by many; while the embryogenic vesicle was said to persist, and from it were derived the now celebrated "globules polaires," or "Richtungsbläschen," which had been variously called by different writers from Carus downwards "white vesicles," "round vesicles," "clear globules," and so forth, and which are now thought to enter directly into the genital organs of the future being; Balbiani considering them of much importance in the evolution, inasmuch as they are found just in the region of the ventral layer of the blastoderm where the genital organs appear.

We have only space for a consideration of one of the instances adduced by Bütschli of earliest ovum development; but that may suffice to indicate the distinctive nature of his work. We select the eggs of *Nephelis vulgaris*. In their youngest state, the yolk is retracted from the delicate membrane, and there is, resting on the yolk, a minute mound of spermatozoa. At a little distance from this spermatozoal eminence there is an eccentrically placed spindle-shaped body, composed of fine longitudinal fibres, which at the equator of the spindle are swollen to a thick shining granular zone. The yolk mass is depressed at one point, and the spindle has its long axis directed to that of the flattened yolk. At the ends of this body there are clear homogeneous spots, from which rays go forth in all directions through the yolk. This spindle-shaped body Bütschli affirms to be the true *germinal vesicle*; and it is this which is carried upward to the surface of the yolk, by the elevation of the upper set of rays proceeding from the homogeneous spot over its upper apex, until eventually this spindle is pushed out of the yolk in three segments. In the part first protruded fine granules appear, and these retain their connection with the fibres in the part still inclosed in the yolk, by fine filaments, which also terminate in a zone of granules. This protruded vesicle is the "Richtungsbläschen;" the real place and relation of which, in the subsequent development of the egg, is nowhere determined by these researches. In the stage of partial protrusion of this vesicle, at about a quadrant from the point of its exit, another clear space arises sending out its radial rays; this enlarges, moves to the centre, and the germinal vesicle—now the "Richtungsbläschen"—is at this time quite protruded. At a point in the yolk determined by the point of exit of the "Richtungsbläschen," two minute nuclei appear, one in the upper margin of the clear space, and the other between that and the point of exit of the said vesicle. They are at first entirely disconnected, and both, by treatment with acetic acid, prove to be true nuclei. But they soon unite in the clear spot or space, and, at its expense, rapidly grow. They become a perfect nucleus with a distinct envelope and fluid contents, and distributed within the latter are dark granules. While these processes have been taking place two of the three segments of the "Richtungsbläschen" have again united, and at the same time the transformation of the nucleus begins. At two points on opposite sides of the nucleus, and in the direction of the long axis of the yolk, there arise clear spots and their accompanying rays. Between these, the nucleus differentiates itself into long fibres, and becomes a spindle-shaped body exactly like the germinal vesicle. An equatorial zone arises in it which is called a nuclear-band (kernplatte), which now divides; and each half recedes to the opposite ends of the spindle-like body. These ends now lose their points and become rounded, and in the mean time occurs the furrowing or constriction of the yolk. Another equatorial band arises in the nucleus or spindle, and when the constriction of the yolk is half accomplished the formation of nuclei of the second generation takes place from the ends of the spindle, these being nuclei in the completest sense. These fuse together and grow at the expense of the clear space—the growth of the nuclei and the diminution of these homogeneous spaces being in all cases correlative. When these nuclei are developed both hemispheres of the yolk collapse, and an almost spherical shape is again resumed.

What became of the fibres of the spindle was never discovered, but about this time the remaining segments of the "Richtungsbläschen" reunite, and in it a system of fibres appears. The following fission processes are but repetitions of this.

It becomes from the above apparent that Bütschli takes it for granted, first, that the eggs studied had been subject to no earlier developmental changes than those with which he starts. Next, that there can be no question as to the identity of his "spindle-formed body" and the germinal vesicle. He further at first claimed the extrusion of this germinal vesicle as the "Richtungsbläschen," as a sole result of the stimulus of impregnation; and ventures to consider that the process of nucleus formation described is widely diffused in the animal world, and that it is probably universal in impregnated eggs.

But (1) there is not the remotest evidence to show that processes of considerable import may not have preceded the condition with which these investigations started; complex processes are still known to occur in the unimpregnated ovum. We have only indeed to turn to the next example given by Bütschli himself to prove all this. In *Cuculanus elegans* the ovum leaves the ovarium without an envelope; and within the yolk is seen the "large *round* germinal vesicle and the germinal spot." The latter vanishes after impregnation, and the germinal vesicle becomes eccentric—and the next thing we are told is that "the germinal vesicle was no longer in the yolk, but *instead of it* there was a spindle-shaped something like that seen in Nephelis." How was the change effected? What were the steps? The transition is all-important, but how it happened is not worked out; and it would be, in so important a question, a matter of the greatest interest to know *how* the perfect spindle-formed body, with which these observations begin, arose. Nothing final can issue in this inquiry until, from first to last, every process and every step therein has been consecutively made out.

(2) The identity of this body with what is known as the germinal vesicle is certainly probable, but by no means certain, at present. It is certainly true that this supposition derives considerable support from the fact that Ratzel

found that in the ripe ova of *Tubifex*, prior to laying, the spherical germinal vesicle lost its spherical shape, elongated, became spindle-shaped with a meridional striation, and so forth, closely resembling the nuclear spindle of *Nephelis*. But as the process is described by Bütschli this would involve the necessity that the *whole* of the germinal vesicle was extruded as the "Richtungsbläschen" in every case. Against this, however, there are irresistible facts; and in an appendix to the volume the author is bound some sense to admit that there are cases where "a part of the germinal vesicle may remain." If this be so evidently there is missing a link in the chain of observation. Difficulties of an equally complex character present themselves in the collation of these researches with those of other distinguished embryologists which it would be hopeless even to attempt to consider here.

3. That the expulsion of the "Richtungsbläschen" is a result of impregnation must also be abandoned. In the text of this treatise the author earnestly contends for this point nevertheless; and endeavours to dispel the force of the very definite results of Œllacher, Bischoff, Flemming, and Beneden. But these are points that may be settled with comparative ease, and it certainly is true that the expulsion of the "Richtungsbläschen" may show itself as one of the earliest phenomena of development in the unfertilised egg. This is now admitted, and in the appendix is allowed by Bütschli.

4. The universal application of the method of development seen in *Nephelis*, although strongly contended for, and carried by analogy into the interpretation of the theory advanced in the third part of the volume to account for the propagation of Infusoria, can only be admitted with the utmost caution. The evidence given by the author is by no means perfect. In *Cuculanus elegans*, for example, he admits that the transition of the nucleus spindle into the "Richtungsbläschen" cannot be made out as in *Nephelis*, but contends that it *ought not to be doubted*. And precisely the same difficulty attaches to the transformations of the nucleus, of which "nothing could be certainly found;" yet the same doctrine is carried over, as though precisely the same phenomena had been witnessed as in *Nephelis*. So in relation to other Nematoids, it is rather inference than evidence that the protruded vesicle is the germinal vesicle, as in *Nephelis*. So in *Limnæus auricularis*, essential points in the origin and subsequent evolution of the spindle and nuclei are presented, not as the result of observation, but of inference, and a leap across a chasm between two preparations of the ovum which show no continuity of evolution, is taken with an assurance that "doubtless," although the intermediate process was not made out, we might be guided by the analogy of *Nephelis*.

These facts are pointed out, not in the slightest degree to detract from the value of the author's observations, but simply to separate them, as such, from the inferences he draws from them. There can be little doubt that great value belongs to the discovery of the nucleus spindle and its behaviour in evolution; and there can also be little question that it is largely original research; but its relation to anterior and subsequent processes is not so definitely discovered. It is nevertheless a source of great interest to find that Balbiani has given such complete and recent confirmation to the main characteristics of the spindle-nucleus.[1] It is true that he does not confirm the division of the equatorial band in the nucleus, and claims to have shown the existence of the clear spaces and rayings accompanying the nucleus-transformations in the eggs of spiders four years before. But evidently a step is gained by these observations on the earliest development of the ovum; although, from the careful work of M. Fol, it is clear that not only the interpretation, but the detail, may be open to question.[2]

W. H. DALLINGER
J. DRYSDALE

(To be continued.)

THE ALKALI TRADE

The History, Products, and Processes of the Alkali Trade, including the most Recent Improvements. By Charles Thomas Kingzett. (London: Longmans, Green, and Co., 1877.)

TOWARDS the middle of last century the price of oil of vitriol was 130*l.* per ton; the same substance now sells at 5*l.* per ton. In the first years of the present century soda crystals sold at about 60*l.* per ton; their present price is about 4*l.* 15*s.* per ton.

In 1861 the Lancashire district produced 8,800 tons of soda crystals, 4,600 tons of caustic soda, and 11,700 tons of bicarbonate of soda. The same district consumed, in that year, 161,000 tons of sulphuric acid and 135,000 tons of salt. Five years later (1866) 194,000 tons of salt were consumed in the same district, while the out-put amounted to 25,000 tons of soda crystals, 11,000 tons of caustic, and 6,500 tons of bicarbonate, together with 87,000 tons of soda ash and refined alkali, and large quantities of bleaching liquor, bleaching powder, &c. The following numbers, obtained from the Alkali Association, show the increase in the alkali trade of the United Kingdom between the years 1862 and 1876:—

	1862.	1876.
Annual value of finished products	£2,500,000	£6,500,000
Weight of dry products	280,000 tons.	845,000 tons.
Raw materials used:—		
Salt	254,600 ,,	538,600 ,,
Coals	961,000 ,,	1,890,000 ,,
Limestone and chalk	280,500 ,,	588,000 ,,
Lime	—	139,000 ,,
Pyrites	264,000 ,,	376,000 ,,
Nitrate of soda	8,300 ,,	12,200 ,,
Manganese	33,000 ,,	18,200 ,,
Total	1,801,400 tons.	3,562,000 tons.
Capital employed in the business	£2,000,000	£7,000,000
Hands employed	10,600	22,000
Wages paid them annually..	£549,500	£1,405,000
Weight of soda exported	104,762 tons.	270,856 tons.
Value of exported soda	£885,245	£2,209,284

These facts enable us to form some idea of the enormous growth of the alkali trade within recent years. This growth has been in a large measure coincident with

[1] Sur les Phénomènes de la Division du Noyau Cellulaire, *Comptes Rendus*, Oct. 30, 1876.
[2] Sur les Phénomènes Intimes de la Division Cellulaire, *Comptes Rendus*, Oct. 2, 1876.

the growth of scientific knowledge. The facts discovered in the laboratory have been turned to account in the alkali work, and the theories of the chemist have not unfrequently received confirmation at the hands of the manufacturer. Conversely, the wants of the manufacturer have hastened the discovery of fresh facts, and the success or failure in the application of these facts on the large scale has reacted beneficially upon the advance of chemical theory. In 1750 sulphuric acid was manufactured by distilling sulphate of iron in earthen vessels luted to glass receivers. The destruction of plant obliged the manufacturer to adopt a better method. The chemist supplied him with the facts: Nitre and sulphur when burnt together produced sulphuric acid. The manufacturer supplied the mechanical means for realising this process on the (comparatively) large scale. Soon after this time Scheele discovered chlorine; the manufacturer, acting on the experiments of the chemist, turned to account the fact that chlorine readily combines with hydrogen. But the impulse thus given to the bleaching trade necessitated a corresponding advance in the manufacture of sulphuric acid. The chambers in which the nitre and sulphur were burnt were enlarged, improvements were adopted, and the price of the acid decreased while the consumption increased.

In more modern times we see the need of a cheaper method for manufacturing chlorine, giving rise to the successful process of Weldon, a process based upon strictly experimental laboratory data, and to the hitherto not so successful process of Deacon. We see the failure of the latter process inducing its discoverer to extend his researches, and as a consequence chemical science is enriched with a valuable paper which throws considerable light upon the general principles of chemical dynamics.

While the history of the alkali trade illustrates the benefits conferred upon manufactures by science, and the requital made to science by manufactures, it also forcibly illustrates the uses which to-morrow may bring for the waste products of to-day.

The monopoly granted by the King of Sicily to one firm in the exportation of sulphur obliged the manufacturers of oil of vitriol to have recourse to some other source of sulphur. The introduction of pyrites led to the accumulation of burnt ore, and this again to Henderson's method for extracting copper, a method which, whether considered chemically or commercially, has proved most successful. The hydrochloric acid sent out from the chimney of the alkali works has, since 1863, been almost wholly condensed, and from this once wasted acid immense quantities of bleaching powder are now manufactured. The acid liquors from the manganese still, although rich in manganese, were formerly sent into the nearest stream, thus causing at once a loss to the manfacturer and a nuisance to the neighbourhood. Now, however, these liquors are turned to use, the nuisance is abated, and the manufacturer is enriched.

But if one is to acquire a just idea of the immense dimensions, and of the importance of the alkali trade from a commercial, chemical, or general point of view, one must learn in detail the history of the manufacture, the development of the processes which gather round the alkali trade as their centre, and the connections which subsist between the practical carrying out of the manufacture and the general principles of chemical science. Such a knowledge may be obtained from the work before us. Mr. Kingzett gives a clear and succinct account of the rise of the alkali trade and of the present state of the manufacture. Notices, sufficiently detailed for the purposes of the general reader, of all the recent improvements are introduced. The allied trades, especially the bleaching powder and soap manufactures, are described.

The book necessitates a general knowledge of chemistry on the part of the reader, inasmuch as processes are everywhere referred to their fundamental chemical principles. He who wishes for a rule of thumb acquaintance with the alkali manufacture will certainly find the information given in this work beyond his scope. On the other hand, the man who, having a general knowledge of chemistry, really wishes to learn how chemical facts are turned to account in manufactures, and also how mechanical difficulties are overcome, cannot do better than study—not read only—the work before us.

The chemical manufacturer also may gain from this work a more extended knowledge of his trade, and he may receive many hints, which, if he be of an inventive turn of mind, he may some day turn to account. The author has evidently endeavoured to treat the subject from the standpoint of the scientific manufacturer, and we think he has very fairly succeeded.

Full details of the more modern improvements of Hargreaves, Mactear, and others in the manufacture of alkali are given. The Weldon process for manufacturing bleach is described minutely, the improvement suggested by Mr. Weldon, whereby loss of calcium chloride would be avoided, is mentioned, and its utility is pointed out.

Of course there are parts of the book which it appears to us admit of improvement. The introduction of an index would add to the value of the work. Might we suggest to Mr. Kingzett that it would be well to re-write the preface, and generally those portions of the work in which he indulges in philosophising? The book begins with a platitude: "The wealth of a nation may be said to be indicated by the magnitude of its commerce." It closes (the last chapter is purely statistical) with a poor simile: "Life may be compared to a spectrum with its bright and dark lines."

M. M. PATTISON MUIR

OUR BOOK SHELF

River Terraces. By Col. George Greenwood. (London: Longmans and Co.)

FOR somewhere about fifteen years no name occurred more frequently in the geological correspondence of our magazines and newspapers than that of "George Greenwood, Colonel," and no letters carried with them a more marked individuality than those to which that name was appended. They never betrayed any doubt or hesitation, but made merry over the doubts and difficulties of other and more experienced observers; they showed in vigorous language that in so far as a correspondent agreed with their author, he was right, that in so far as he differed he was wrong. Fathers in science like Lyell and Darwin, as well as striplings, not yet emancipated from geological long-clothes—one and all needed instruction and correction at the hands of the enthusiastic Colonel. He spoke of the

geologists of the country as schoolboys, whom he had to drill in the beggarly elements, and divided them into classes according to their acquirements or their aptitude to receive his lessons. He began by enforcing his views as those of Hutton and Playfair, and gradually so identified himself with them that he regarded them and the very words expressive of them as his own property, which no one should claim or touch except in the way he chose to sanction. Peace be with his memory! He did a good work in his time. Men gladly overlooked his personal failings for that sound sense so often underlying his self-asserting remarks about geological forces which had not been adequately understood in this country when he began his crusade of "Rain and Rivers." The present volume is a reprint of his letters on all manner of subjects, written at different times from 1859 to 1875. But surely its publication was not needed for the scientific reputation of the author. The letters are given as they originally appeared, full of references to passing incidents, and to letters by other writers, which of course are not inserted, but without which Col. Greenwood's diatribes are often unintelligible. There is no attempt at editing. The title of the book also is misleading. Instead of a treatise on river terraces, it is a medley of clippings from the columns of various periodicals relating to such varied subjects as Spelling, the Possessive Augment, Source of the Nile, Glen Roy, a Horse-Chestnut Tree, Rain and Rivers, Sirloin, Pronunciation of Latin, Lakes with Two Outfalls, a Beech pierced by a Thorn Plant, Origin of the Chesil Bank, &c., &c.

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.]

Tait on Force

IN Prof. Tait's lecture on "force," which its writer seems to have intended as a model of perspicuity and accuracy, we are told that "we must measure a force by the rate at which it produces change of momentum." Nothing could be clearer or more satisfactory than this statement. Then Prof. Tait proceeds to tell us what force "is," and we read—"Force is the rate of change of momentum"—giving to this word "is" the meaning which the so-called metaphysicians give to it; and it seems to me that we might jangle over it for ever, without ever knowing whether this latter statement be true or not; for although we may all agree as to the proper *measure* of a force, it seems to be more difficult to tell what force "is." Possibly we might roughly measure the hunger of a man under different circumstances, by determining the number of pounds of beef he would consume, but it would be hardly warranted to say that hunger "is" a certain number of pounds of beef.

Perhaps it may be advantageous to apply the name force to the thing which we have heretofore called rate of change of momentum due to force, but I cannot imagine how any one can think that a certain "rate of change of momentum" can produce a unit of momentum in a unit of time. Until this shadowy "phantom" called force can be brought a little more sharply into focus, it seems to me that considerations as to what it "is" may profitably be left to those who appear to delight in the obscurity of obscure things—the metaphysicians.

St. Louis, June 4 FRANCIS E. NIPHER

P.S.—On showing this note to a friend, my attention was drawn to a note by Robert Napier in *Engineering*, which makes the present one seem almost superfluous. Remembering, however, the difficulty which I had in understanding these very points on account of the loose way in which they are put in many text-books, I feel that too much cannot be done to prevent such things from going into text-books in the future.—F. E. N.

[Prof. Nipher's censure does not apply to my lecture, simply because he fails to remark that I had two objects in view, (1) to point out the sense in which the word *force* must be used if we desire to avoid confusion; (2) to point out that, in all probability, there is no such *thing* as force. Under the first head I of course referred to Newton's "Laws," and in them language is used which at least suggests the objective reality of force as the *cause* of change of motion. We must take Newton as we find him. But there is no inconsistency in afterwards proceeding to give reasons which appear conclusive against the objective reality of force.

With some of Prof. Nipher's other remarks I can cordially agree. Since my lecture was published I have been in almost daily receipt of passages containing errors amounting often to the wildest absurdities, due to misuse of the term force. The latest to which my attention has thus been called is in the *Cornhill Magazine* for June. Here the non-scientific public is gravely told that "*what mathematicians call the moving force exerted by the earth on the moon is eighty-one times greater than the corresponding force exerted by the moon on the earth.*"—P. G. T.]

On Time

If I understand V. A. Julius's letter in NATURE, vol. xiv. p. 122, on the measurement of time, it may be thus summarised:—

As equal times, unlike equal linear magnitudes, cannot be brought alongside of each other, their equality can be ascertained only by means of velocities. (This will not be disputed.) We define those times as equal during which the same space is traversed by equal velocities; but the postulate that a velocity, *e.g.* that of the earth's rotation, continues unchanged, is arbitrary, incapable of proof, and justified only by practical convenience.

It seems to me, on the contrary, that the postulate is not necessarily arbitrary, but may be absolutely justified by facts. The best case to put is that of the pendulum, which, according to Sir William Thomson, is probably capable of measuring time with greater accuracy than the motion of the earth itself. If we assert that equal forces acting through equal spaces produce equal velocities (and this is rather a definition than an axiom), then the assumption of the equal velocity of all the pendulum's strokes postulates nothing except that the force of gravitation continues unchanged. I admit that I see no way of proving this, but it may be safely assumed in the absence of any known or probable cause of change. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, June 19

The Antiquity of Man

I HAVE no desire to enter into the controversy respecting the age of the palæolithic implements found in brick earth near Brandon, by Mr. Skertchly. I had the great pleasure of going over some part of the ground with him and Mr. Belt in November last. But what I saw then was not sufficient for me to make up my mind upon the question. Of course Mr. Skertchly, with his immense experience, has far more evidence in his repertorium than a cursory visit could afford to me.

My object in writing this letter is to point out that, if it should eventually be proved that *a* glaciation of the surface has occurred in East Anglia subsequent to its human occupation, but one which is not identical with, but posterior to, that glaciation (whether land or marine) which deposited the great chalky boulder-clay, then this is no more than I put forward many years ago in my papers on the "warp" (*Geol. Journal*, 1866); and on the "glacial origin of denudation" (*Geol. Mag.*, 1866); and on the "denudations of Norfolk" (*Geol. Mag.*, 1868).

I think this is the direction to which the course of opinion appears to be tending, and I ask you kindly to bring under the notice of the younger generation of geologists the speculations of an elder brother.

I call the product of this supposed glaciation "trail." The more orthodox, I believe, consider it to be "rain wash," and I had hoped that some competent writer would have thought me worth confuting. But none has done so. I have reason to think that one of your correspondents did actually put down as boulder clay this very deposit, at one of the most important sections which I saw near Brandon. O. FISHER

Harlton, Cambridge, June 28

Museum Reform

No one acquainted with the condition of the greater proportion of our provincial museums can do otherwise than confess with sorrow that much of what is alleged against them in the paper of Mr. Boyd Dawkins is too true. While fully concurring in all he says as to the actual state of matters in these amorphous receptacles of curiosities and conceits, and as to the crying need for reform, you will perhaps allow me to make a few comments as to the causes which contribute to keep museum collections in their present disreputable condition, and the means by which they may be worthily organised, and raised to their high and proper position among the educational agencies of the country.

It is necessary in the first place to accept Mr. Boyd Dawkins's glorification of the collecting instinct with some modification or rather amplification of its scope. A man is indeed "poor and much to be pitied" who is not a collector in some sense; but it does not require demonstration that many of the best and greatest benefactors of mankind are not collectors in a way that contributes to the building up of museums. Statesmen, soldiers, poets, philosophers, and orators are not of necessity poor and much to be pitied because they may not devote their leisure to the collection of coleoptera nor find solace in the beauties of Lucca della Robbia. In nine cases out of ten, indeed, the collector is a person of one idea, and that idea is that the gathering, labelling, and arranging of the objects of his fancy is the beginning, end, and sum of science. He is generally an estimable person; but as regards scientific culture he is quite as well employed in collecting spoiled postage stamps as he would be in gathering together the species of any of the great divisions of the animal kingdom. When we come to the tenth man—the intellectual collector—we find a really scientific worker, but one necessarily confining himself to a limited field. He is in short a man with a hobby, or, to put it more courteously, a specialist. Put a man of this select class in charge of a provincial museum, and while probably he is too wise to speak slightingly of any department of human knowledge, he will inevitably develop his own special subject at the expense of all others. A geologist draws towards him rocks and fossils, an entomologist collects in the particular group of insects to which he has given attention, and an archæologist looks only or mainly for antiquities. If the man is a simple collector of the ordinary type he knows nothing or despises everything beyond his region, and hence in part the jumble of ethnology, art, and science which Mr. Boyd Dawkins so graphically describes.

A specialist, though an indispensable cultivator of science, is a very bad museum curator. A curator should be like a newspaper editor, a man of general knowledge and culture. Unlike an editor, he should belong to no party, but be possessed of catholic sympathies in science and art; ready to accept and use the assistance of specialists, in a way that will subordinate all departments to one harmonious general plan. Further, he should possess an experimental knowledge of the routine duties of a museum, such as can only be obtained by a training or apprenticeship in a well-organised museum.

No provision, I need hardly say, exists at the present time for training young men to museum work, and there is no pecuniary inducement held out for lads to seek curatorial qualifications. The training obtained in the great metropolitan museums is special; and in the government service there is no hiving off of apprentices. Municipal and free library authorities have not yet learnt that a well-equipped museum is an expensive institution, and though many corporation dignitaries may spend annually 1,000*l.* and upwards on purchases for their private collections, it does not occur to them that it is necessary to do more than open the doors of a public museum or art gallery, and allow collections to accumulate, arrange, classify, catalogue, and conserve very much of their own accord. And so we obtain the dusty, misleading, higgeldy-piggeldies which do duty in provincial towns as "museums."

Before these institutions can rise from their present dismal estate it is essential that much more money be devoted to them. Of course it does not matter whence the funds come—from public rates or private benefaction—provided it comes honestly; but there is, as the law now stands, hardly in any town sufficient rating power to build and maintain a museum adequate to the population and wants of the locality. Free library boards with their penny rating limit have in many instances committed themselves to very ambitious mistakes by instituting numerous district libraries, and throwing in a public museum to the bargain, under the delusion either that their penny is like the wizard's inexhaustible bottle, or that these institutions will live and flourish "without visible means of support." The result is, that while libraries have been crippled and half starved, ratepayers have been justly disgusted with the very name of museum.

The provincial public mind, both official and extra-official, stands sorely in need of enlightenment as to the nature and functions of a museum. The education of opinion on these points is the first step required for the elevation of local museums. With that effected, enlarged rating power, a demand for competent men, and adequate support to institutions on a broad educational basis would soon follow. Local museums, ceasing to be mere curiosity-shops, receptacles of "relics from Sedan," "water from the Jordan," with six-legged cats and similar monstrosities, would become storehouses of well-selected information and material for the use of teachers and investigators, as well as instructive and elevating resorts of the general public.

No class of institutions existing could be made mutually more helpful than museums. Duplicates innumerable go to wreck and destruction in the stores and cellars of almost every museum, while certainly many kindred institutions stand in need of what is simply an encumbrance to some. Similarly with labels and stores of information, each institution at present stands apart, working painfully, and perhaps erringly, at tasks which might well be spared, seeing that it is and has been done over and over again in other institutions. Again, one locality possesses rare and unusual facilities for obtaining particular classes of objects, and that advantage can, by a system of exchange, be made properly beneficial to its own museum by drawing what it needs from others. Further, in these days of comparative infancy, the experience of the officers of the older museums would be of unspeakable value to those struggling amid difficulties of which they barely recognise the nature; and to all, the countenance of the great institutions—which should be prepared to stand more *in loco parentis* than they at present do—and the advice and help of their specialists would be of much advantage. In these days of conferences, associations, and unions, it is manifest that there is room for a conference of museum keepers, and no one can doubt that vast good would result from drawing the officers of museums of all kinds into closer relationship with each other. Will the energetic officers of South Kensington not display once more their organising talent by bringing together such a conference, which, it may be hoped, would result in a permanent union among museum officers.

J. P.

Taunton College School

MAY I ask the insertion of the following brief remarks:—

The writer of the article in your paper of the 28th on Taunton College School is under some strange misapprehension, which perhaps may account for his unfavourable criticism of the schemes of the Endowed Schools' Commission. He clearly implies, though he does not positively state, that the present disturbance at Taunton (of which I know nothing) and the scandal at Felsted two or three years ago are in some way attributable to the wrong constitution of the governing body, under schemes of the Endowed Schools' Commission.

Taunton College School is not under a scheme of the Endowed Schools' Commission, and no scheme was ever proposed for it by that body. A scheme for Felsted Grammar School was proposed by the Endowed Schools' Commission, with the hearty goodwill of the late master, but was rejected by the House of Lords on the motion of the Bishop of Rochester (now of St. Alban's). The trustees who dismissed Dr. Grignon were the very body whose constitution our scheme proposed largely to modify, and who were in consequence not a little annoyed.

Your writer will, I hope, excuse my saying that he will serve the cause of science and of schools much better if he does not weaken his attacks on the guilty by hitting, or making feints of hitting, at the innocent.

HENRY J. ROBY,
Late one of the Endowed Schools' Commissioners

Manchester, June 29

Hog Wallows

I HAVE been watching with some interest the progress of the discussion on the "Hog Wallows" of California, which has been in progress in your paper during nearly all of this year. When a member of the California Geological Survey Corps, I

had numerous opportunities of studying the phenomena in that and the adjoining states of Oregon and Nevada; more especially in the southern parts of the desert. There they are developed on the largest scale, and there their origin is obvious.

Prof. Le Conte's account of them wants but a single word to have settled the question. I attributed them, then, exclusively to the action of the wind, and after reading what others have to say about them, see no reason for changing that opinion. The Professor says, "I attribute them to surface erosion." Had he inserted *aërial*, nothing more would have been wanted; although, since he speaks of weeds and shrubs taking possession of them, subsequent to their formation, he does not seem to have exactly hit on the *rationale* of the process.

One case may serve as an illustration. In the southern end of the Reese River Valley, Nevada, is a broad, perfectly level plain without a water-course; only a few shallow dry gutters show where the rain water runs to scattered spots, where it sinks or evaporates. The region is almost rainless. The plain is covered for many square miles with these mounds, varying up to four or five feet high, and up to twenty, thirty, and even perhaps forty feet in diameter. In every case they are made up of only the finer particles of the soil, the coarser grains and gravel being visible in the interspaces. The dust and sand has in all cases been heaped up in and around a clump of sage bush which continues to grow out of the top of the mound. Little vegetation grows on the flanks of the mounds, and when it does, it forms the nucleus of a subsidiary hillock. The mounds are thus formed by building up, and only the intervening spaces are caused by an erosion, taking place to day, and not caused by water, much less by ice. WM. M. GABB

Puerto Plata, Sto. Domingo, June 5

Fertilisation of Salix repens

DURING May I was watching the movements of the insects on a plant of *Salix repens*, when I noticed some facts which may prove interesting to some of your readers. It was mainly visited by the common hive-bee (*Apis mellifica* ♂) and the humble-bee (*Bombus terrestris* ♀). The former of these flew gaily about from catkin to catkin merely taking one bite at each; but the latter went far more systematically to work; it never flew at all, but crawled in a ludicrously feeble way from catkin to catkin, and once on a catkin it cleared it thoroughly, thrusting its proboscis between every pair of florets. I do not know whether this greater thoroughness is at all times characteristic of the humble-bee as compared with the hive-bee and should much like to be informed. And another thing which I do not understand is, that one of these humble-bees appeared to have two kinds of pollen on its legs, one that of *Salix repens*, the other of a much darker and more-orange colour, though when examined under the microscope the grains proved to be of the same shape. H. H.

Wellington College, Wokingham, June 30

THE FUTURE OF SANITARY SCIENCE—POLITICAL, MEDICAL, SOCIAL[1]

I COULD have wished it had been in my power on the present occasion to produce one of those essays which appeal to the imagination while they prepare the mind for the reception of sanitary principles and practice. Such essays are tempting and, in their place, instructive. To-day I am bound on a voyage less pleasant, yet I hope not less useful.

There has recently been called into existence a new society under whose summons we now meet. The society has assumed to itself the expressive name of the Sanitary Institute of Great Britain. It starts as a voluntary effort by men and women who are willing and anxious to give effect to those teachings of sanitary science which the past half-century has revealed. It invites all who are concerned to utilise the knowledge that has been acquired in that time. It wishes to encourage new research. But it has for its most anxious care to render useful to mankind at large the accumulated store of knowledge which at this moment lies ready for so many grand purposes relating to health. It accepts as its object, work for health, health of all the human family.

Shall some one say the object is ambitious? Yea, we reply, it is confessedly ambitious. Shall some one say the means at command for the work to be attempted are weak? Even so. Life is short, art long. Yet the short yields the long, and but for the short the long could not be. It is out of these littlenesses of human effort that the greatnesses follow. Or, as Benjamin Rush very forcibly puts it, and simply as forcibly: "There are mites in science as well as in charity, and the ultimate results of each are often alike important and beneficial."

It is my fortune, good or bad, to have to preside over the council of this new society. Of the ability of those who form the council, and of their experience, I need not speak in detail, for their names are familiar to the world. They represent, I may say, sanitary science in all its branches, and from them, working harmoniously together, good results must be expected.

It seems fitting therefore as we enter on our work to look forward to the future. It is a part at least of our duty to look towards the future with the view of seeing in what directions we may best proceed; what assistances we may have to call upon; and chiefly what great powers we may have to consult and propitiate.

The three great powers with which our society will have to treat are the political, the medical, the social. From each of these we shall expect constant assistance. To one or other of these, whatever we do, our work will be transmitted or transferred. They will bring it into practical form and effect, or they will reduce it to nothingness. We can suggest and set forth initiatives, and with that our functions are complete in each particular branch to which we address ourselves.

It is our special duty to keep this special fact steadily in view and to limit our labours by it. It too often happens that young societies like young men are apt to believe that they can conduct national processes as easily as they can conceive them, and under this belief fail most signally with the best of attempts. I remember in my early career getting a lesson from one of our late well-known statesmen on this very point. I was explaining to him the efforts I had made in 1855 and the succeeding three years to establish a registration of the diseases of this kingdom, and I bewailed the hard experience which proved that the greater the scientific success of the effort the more impossible it became to carry it out. In fact, said I, in a pitiful strain, the success almost ruined me in mind, body, and estate. "Served you right," was the immediate reply, "Served you right. If individual men could carry out national projects where would be the nation?" The reply was hard as it was unanswerable, and from that time to this I have given up all thoughts of doing more than sowing seed in the field of literature and leaving it to the chance of fructification on that extensive soil; or in showing some mere model of experiment which, perchance, may grow into working form. And this, I think, is the whole natural scope of our Institute,—to sow the

[1] An address delivered before the Sanitary Institute of Great Britain at the Royal Institution, on July 5, 1877, by Benjamin W. Richardson, M.D., LL.D., F.R.S.

seed of sanitation; to think out plans of projects for working methods; to lend its many minds, as if they made up the mind of one man, for devising from the past the best for the present, and respectfully to declare our conclusions.

The directions in which we shall have to move, the lines on which we shall have to move, are, I repeat, chiefly three—the political, the medical, the social. The powers on these lines must be approached in every work of ours, however simple, however complicate it may be. I shall try, as the title of my discourse explains, to indicate certain points in which we are most likely to come in contact with these powers and the changes we may expect to work in and through them.

The Political Part.

In this country political action has been varied in relation to sanitary improvements. Sometimes political necessity has crossed sanitary progress, as, for example, in the imposition of a tax on sunlight, on foods that are essential to life, and in the granting of licences for the sale of pernicious drinks. At other times, and by fits and starts, political action has been in aid of sanitary work. So far back as the reign of Edward the Third, 1361, a royal proclamation was made through Parliament for preventing the slaughter of cattle in the streets of London because of the pollution of the streets and the drains which arose from that cause. From that time under great emergencies other similar acts came into force. They rarely lasted very long. As the urgent necessity for their existence passed away, they were allowed to fall into abeyance, and no permanent machinery was kept in order for insuring their continued and effective action.

Let me not, however, in saying this, be understood as conveying any special charge of neglect against English legislation. It is just to state, as an historical fact most creditable to our national history, that our legislators have by a long precedence taken the lead in sanitary affairs over those of other nations. In 1802 the great sanitary act for regulating the labour of children in factories set the example from which much useful legislation has followed at home and abroad. In 1838 that great original sanitary scheme for the registration of the births and deaths of the kingdom was inaugurated, to become a collection of facts relating to life, and disease, and death, of which there is elsewhere no parallel. And, since the era of the Crimean campaign, so much legislation has been attempted bearing on health, I dare not attempt even to enumerate the titles of the different measures that have been introduced. At this moment there can be no doubt as to the sincerity of our governments, of whatever party they may be composed, for dealing with every subject relating to the public health in an efficient manner, and in as rapid a progression as the slow and sure mode of parliamentary procedure will permit. The subject indeed presses at this moment with so much force on the governing mind, that if there be any danger ahead it is the danger of too miraculous a draught of small enactments, to the exclusion of comprehensive measures which all who run may read.

In saying this it is necessary to guard myself against error of expression. By comparison with all the nations of the world beside, we have obtained legislative measures which are splendidly comprehensive. No other country in the world can present an approach to the Public Health Act of 1875. That Act, as far as it goes, is admirably constructed. Its constitution of sanitary authorities throughout the kingdom; the power it vests in those authorities to appoint learned medical officers of health; the provisions it makes for securing to each locality better sewerage, freedom from nuisances, improved water supply, regulation of cellar dwellings, governance over offensive trades, and removal of unsound foods; the provisions for prevention of spread of infection and for the erection of hospitals and mortuaries; and the provisions for the regulation of streets and highways, lighting of streets, establishment of pleasure grounds, and regulation of slaughter houses; these, as well as the general provisions for the carrying out of the Act, are most commendable as practical plans by the working of which the nation may be tempered into sanitary mould of thought and character.

In a word the Act of 1875 is an improvement of the first degree on all that has preceded it, and although much of it, by the necessities of the constitution of our country,—which recognises the domination of free will even in its age of ignorance,—of a permissive nature, the working of the Act must in a few years remove a great amount of disease from the land and prevent the invasion of diseases of an epidemic and spreading type.

Sanitation however admits of being studied from two distinct points of view, the legislative and the scientific. The legislator may say, and perhaps with justice, that the production of such a measure as the Act of which I now speak is as much as can be done. The man of science may say that this is childish talk, that much more requires to be done, and that after all that which has been done, though it be comparatively great, is practically imperfect and very little. Science in this respect is always in advance of legislation, and that is her true place,—the pioneer's place. I remember the time perfectly when every fragment of the Public Health Act of 1875 was in the hands of men of science solely, and was called a chimera, over which great lawgivers shook their wise heads and passed by.

At this moment the positions of science and legislation are relatively the same as they have ever been, and it is fair for us men of science now as in the past time to declare the way ahead for the law-maker. I shall proceed again, therefore, as I have often before, to indicate one or two new starts in sanitary legislation, not from the legislative but from the purely scientific point of view, uninfluenced by the many and vehement individual grievances and troubles which beset the path of the minister of state. In so doing I shall indicate also, by inference, what I think our society ought to support in the sanitary policy of the future.

In the first place, then, we ought to expect in the political progress of sanitation that there will be established in connection with the Government one central department in which every subject, directly and even indirectly, connected with the health of the people, will be considered. This department, it is to be hoped, will be under the control of a Cabinet Minister, and will supervise the sanitary work performed at present by the Local Government Board, the Registrar-General's department, the sanitary regulations of jails and reformatories, and all the duties now pertaining to the supervision of factories, in so far as the health of the employed is concerned: in fine, every sanitary work that can be weeded out of every other department of the state.

To such a central board or department a specific name is necessary. The name should be as distinct as that of the department for war, for the navy, for the exchequer, or for the post-office. The name, it is to be hoped, will be emphatically the Health Department, and the chief of it the Minister of Health.

It may be urged that substantially we are drifting into some such order as is here suggested. It may be urged that the Local Government Board is step by step assuming the duties assigned, as above, for the State Department of Health. To some extent this is true, and it might be advisable, for the sake of the connection which must

always exist between such a central board and the various local boards, in the kingdom to add to the name of Health Department that of Local Government Board. But for the sanitary object the leading name must be Health, and Local Government must come in merely as indicative of the connections that exist between the State and the local centres—as the machinery.

In this question of progress there is involved an immense deal in a name. It is essential to the scientific sanitary teacher that every reasoning mind in the kingdom should become familiar with the two significant words, public health, or national health. It is equally necessary to let the people know fully that the Government has the health of the country under its general and wise supervision. But it is utterly impossible to make either of these facts understood by the masses so long as any sanitary authority, central or local, has a title which fails to convey the meaning of its functions. To speak to the masses who are listening to a lecture or discourse on health about a local government board is only to confuse them. They ask you afterwards what it all means, and they go away imbued with the impression that it means anything except what relates to the health of the people.

I am speaking very practically in suggesting that in the course of political sanitary progress it is an absolute necessity for success to give its proper and only name to the department of state which presides over the national health. I do not state too much in declaring that every public measure would carry more weight if it went forth as being under the supervision of the health department. It may appear a refinement of illustration, and yet it is a sound argument that vaccination would have met and would meet with far less opposition if it were enforced under the general supervision of a State department of health. As it is the people connect the carrying out of vaccination with something other than health, and even as distinct from the idea of conservation of health. It is looked upon as a legal tyranny, having no scientific setting forth of its intention, and as springing from no scientific authority. If you attempt to reason with its active opponents on the subject, and refer to the authority that exists, they dispute the competency of the authority in name and form; and, foolish as the objection may be, it is potent for obstruction.

In making this suggestion there is no necessity to offer a word against the continued action of local self-government. The work of the local centres in all parts of the kingdom instead of being in any degree curtailed and restrained, should be encouraged and maintained. In the sanitary local work the word health should, however, again come forward as the one prominent designating term to which all others should be subject.

Our Sanitary Institute could not turn its attention to any more suitable labour than that of inculcating the necessity for the institution of one state department exclusively devoted to the health of the people. In the success attending such an effort a double result would be achieved. The country would have secured for it the best and most direct guidance on its most vital interest, and scope would be given to the industry of men of science in a new direction. Men, whose lives have been devoted to the study of life and health, would be prepared by their devotion for the accepted service of their country in public form, and the Houses of Parliament would become, at last, congenial spheres for their labours. The Houses would be strengthened by such adhesions; the men would be more useful and honoured.

Another work in the political line which will be demanded in the future for the benefit of the sanitary cause is the preparation of such a digest of all our practical sanitary laws that every person of intelligence can read and understand what may be legally enforced for the maintenance of health. What may be done in this direction ought to be so simple and so plain as to be brought into a school-book. Not a line should be left for the subtlety of the legal brain to twist into contortioned illegibility. The laws by which the health of a man, and thereby of a nation, can be preserved to the utmost, are so simple in nature that nothing but the utmost simplicity can truly express them, and the whole labour of the future, if it is to be of any service whatever, must be directed to the discovery and establishment of such simplicity of exposition and direction. Up to the present time much that has been done has been provoked by that most untrustworthy of all human provocatives to action,—fear. Some great epidemic has occurred that has caused universal dismay; some great catastrophe has occurred, like that of the Crimean campaign, which has excited universal criticism on the failure of sanitary provisions by the authorities of the nation. Some such slip has been permitted in sanitary rule as that which recently let scurvy undermine the workers during a great enterprise of discovery. Straightway on the heels of such events there have been commissions of inquiry, and as a direct or indirect result there has often come forth some particular enactment. Or—and this is by no means rare—some individual of the House of Commons, impressed with the danger of a great national evil, has pressed for a national remedy, and, by steady persistence session after session, and by showing that he never knows when he is beaten, has forced the Government to take up his measure and to carry it through.

From these modes of legislating for health we have obtained many minor acts which fill and refill the national statute books. And still this process promises to go on, a process of labour in a circle with much loss of time and expenditure of force without ultimate progression.

It would be vain to find fault with the past for its doings. As vain to find fault with the State for meeting State disorders by empirical remedies as it would be to find fault with the physicians of a former day for the same mode of procedure. If the people demand a recipe they must have it, be it from the State or the family physician. The question that now comes forward is whether the time has not arrived for ceasing to treat the health of the nation by specific or supposed specific remedies for particular errors, and whether we may not find in the future a few very simple and natural guiding principles on which all acts of Parliament relating to the health of the people may be based?

Before this effort can be attempted the existing acts that touch on health,—public health acts, metropolitan health acts, contagious diseases acts, vaccination acts, factory acts, acts relating to the importation of cattle, adulteration acts, and others relating to prisons, workhouses, and the like, and which, if they even lie latent are not repealed,—these, one and all require to be considered together, with the view of determining whether an English or even a British act of settlement for the vital regeneration of the realm is not practicable on a simple natural basis of natural requirement.

I am fully aware that this suggestion carries with it the idea of a gigantic labour; but it will have to be done, and once fairly tackled I dare say the apparent difficulties will readily dissolve away. It is a mere question between doubting and attempting: and we all know and feel that—

> "Our doubts are traitors,
> And make us lose the good we oft might win
> By fearing to attempt."

Supposing the existence of an efficient central department of health acting under the direction of a minister of health, a grand new duty, as it seems to me, would be to determine what is the evil or what are the evils that have to be removed in order that the cleanest bills of health may be regularly presented to the nation. Without such preliminary knowledge all sanitary work is unsound to the last degree. It were as wise for me to

write a prescription for a man without inquiring into his disease, his antecedents, and modes of life, as for the State physician to prescribe for national sickness without inquiry into the nature of the sickness, its antecedents, and the cause or causes that led up to it. The great work, therefore, and indeed the first sanitary work of the future, standing before all other sanitary legislations except the formation of the central authority, is the systematic enumeration, week by week, of the diseases of the kingdom, through the length and breadth of the kingdom. It is utterly hopeless to attempt any decisive measure for lessening the mortality, which is certainly more than double what it ought to be, until this State labour is faithfully carried out. It is vain, comparatively speaking, to know what totality disease hands over to death, unless we know also what health under one or other cause of disturbance yields over to disease. Physicians and statists strain their eyes to try to get at the extent of disease. Laborious geographers like Mr. Haviland spend years in constructing maps from the tables of mortality, in order to get a mere approximation of the distribution of disease in England: and meanwhile disease itself, constantly cheating the observers, is making its way without being under any systematised recorded observation.

For the omission of a registration of disease there is no conceivable excuse. The thing has only to be done. The organisation of the Registrar-General's department has fully opened the way to the collection and the utilisation of the facts relating to birth and death. These elements swing in the statist's balance readily, and are weighed by our consummate state weigher of life and death, Dr. Farr, as accurately as the Chancellor of the Exchequer balances the national ledger. With equal readiness Dr. Farr, if the data were collected for him, could tell from week to week the health as well as the mortality of the kingdom. In a short time, under such regular record, the whole nation would know the reigning health, the reigning disease, of every centre of life. And if, as might easily be done, the diseases of the lower animals and the diseases of the vegetable kingdom were included in the returns, all the facts of disease would be completely rendered.

I think I have already referred to an effort I made many years ago to carry out this design of registering the diseases of the kingdom. I refer to that effort again for a simple reason,—for the purpose of indicating that there is really no greater difficulty in getting the facts than there is in utilising them. I attempted no more than the registration of the epidemic diseases, and I could afford no more than the publication of a quarterly abstract of the data that were forwarded. But in a short time fifty medical observers were sending in returns from as many stations, extending from St. Mary's, Scilly, to Lerwick, in the Shetland Islands. These stations could easily have been increased to any extent, and the amount of information regularly communicated was indeed most valuable.

Two facts connected with this attempt are perhaps worthy of note, one as showing something determined, and the other as showing something suggested. In the returns sent from the district of Canterbury in the spring quarter of the year 1857 was included the first account of the invasion of this country, at least in any known time, by the disease since then so prevailing and fatal, diphtheria. This disease first appeared in the little village of Ash, and was called the Ash fever. The outbreak was observed and recognised by Mr. Reid, of Canterbury, and was reported to my register by Mr. Haffenden, who collected for me the facts of prevailing diseases from eight medical observers living near to him, of whom Mr. Reid was one. The first facts of a new disease in this country were thus recorded on the spot, which is something even as matter of history. How such a fact, reported at once to a central government authority, might be dealt with; how promptly a central authority so advised might act in arresting a fatal epidemic at its origin, and what national service might be rendered thereby, you, quite as well as I, can judge!

The fact of a suggestive nature springing from the working of the returns is not less interesting. The labour led me to refer to the returns of sickness sent every week by the medical officers of the Poor-Law districts to their boards of guardians. I found that these returns, over 3,000 in number, which, when they have served their local purpose, are practically worthless, could by the slightest modification be utilised as returns of the sickness of all the sick parochial population under official medical care, and I submitted a plan for such introduction to public approval and to the Government, but without effect. Yet if the plan had been adopted from those three thousand weekly returns, cast away and still cast away, I calculate that 156,000 tables of disease per year would have been submitted to scientific analysis which, since the time when the suggestion was first made, would have multiplied into 3,276,000 tables, including in each table a record of at least ten times as many particular examples of disease. To what important national uses such an array of facts systematically arranged and examined could have been applied you, as well as I, can judge! And still neither of us can judge effectively, because in dealing with data taken from nature there is always something important to be elicited which never was looked for, and often, too, that something unlooked for is better than that which was specially looked for.

Our Sanitary Institute will do well in continuing to press this scheme for the registration of disease on the Government, and it may greatly assist the work by lending its mind to the best means of collecting the facts on which the weekly reports of disease will have to be based. I might enlarge on this part of my subject, but I should prefer to remain silent until the views of the medical officers of health, now a large and influential class, have been correctly ascertained. My present purpose is served if I have sufficiently directed public attention to the principles of the design.

In the future of sanitary science the politician must come forward more determinately than he has yet done, in order to secure for those over whom he governs three pure requisites—pure water, pure food, pure air.

The Public Health Act of 1875 deals with the water question, and makes provisions for the local authorities to supply their respective districts, by means of a company, or by independent action. For my part I see no hope of any effective change for the better by these propositions. It is utterly hopeless to trust to companies in a matter of such vital moment. It is equally hopeless to trust to the undirected action of local authorities. If we trusted to such agencies for the collection and delivery of letters by post, does any one suppose that the results of our present postage system would be attained? Yet important as intercommunication by letter is, it is less important than the supply in due quantity and pure quality of that vital fluid which makes up three parts out of four of every human organism, and which is wanted as much by the millions who never receive a letter, as by the millions who do. In this political part of sanitation, the Government must do one of two things. It must either produce a process or processes for pure water supply, and insist on every local authority carrying out the proper method; or it must,—and this would be far better,—take the whole matter into its own hands, so that under its supreme direction every living centre should, without fail, receive the first necessity of healthy life in the condition fitted for the necessities of all who live.

By recent legislation we have some security for obtaining fresh animal food, and foods freed of foreign substances or adulterations. The penalties that may be inflicted on those who sell decomposing, diseased, or adul-

terated foods are beginning to have effect, and much good is resulting. Nevertheless, even here the legal rule falls short of completeness. The inspection of animal food is as yet most unsystematic and imperfect. With all our richness of means ready at command, we have not approached that admirable system for the inspection of animal foods which our Jewish brethren, through ages of ignorance and oppression, have managed so efficiently to carry out, and which has entirely saved them from many of the great calamities of disease that have fallen on less careful people. The complete inspection of animal foods, including milk, is a clear piece of sanitary law which, from day to day and hour to hour, must ultimately be enforced.

Imperfect as legislation may be in respect to supply of pure water and food, it is advanced in these directions when the steps it has taken for supplying pure air are brought under observation. There is no practical legislation of any kind on this requisite. The air of our large towns is charged with smoke and impurity. The air of our great factories is charged with dusts which destroy life with the precision of a deadly aim. Dr. Purdon, one of the certifying surgeons under the Factory Acts, reports that in the flax-working factories under his care the carders, who are all females, if they get a carding-machine at eighteen years, generally die at thirty years. Can any fact be more terrible than such a fact, that a girl of eighteen should have to live by an occupation that will bring her existence to an end in fourteen years, and to that end with all the prolonged wasting, sleeplessness, suffering, incident to the disease consumption of the lungs. If it were the fate of these doomed workers that at the close of fourteen years' work the majority of them were taken forth and shot dead in an instant, their fate were infinitely better than it is. The heart of the nation would thus be roused, and the law in all its majesty would be put in operation to arrest the progress of the crime and to punish the offenders. Yet, year after year as effective an offence goes on, and because the results of it is hidden in the sick-room there is no arrest of its progress, no punishment for its commission.

In the application of political science to preservation of health not one subject presses more earnestly than the question of the supply of a pure atmosphere to the millions of industrials of these islands. In an inquiry I recently undertook on this matter for the Society of Arts, Manufactures, and Commerce, the facts that came before me were as of a new world. You will find a compact mass of these facts in the lectures I had the honour to deliver before that learned society. Those lectures contain a tithe only of the things seen. I am quite sure that our leading politicians can have no adequate conception of the mental and physical condition of the great industrial classes, or of the need that exists for reconciling those classes to their fate. These truths are plain.

The catechism has failed to satisfy them. Bad air keeps up in them a depraved mental as well as physical state. Their poverty and not their will consents to their condition. In short, as a physician dealing with the physiological and psychological phenomena belonging to a class instead of an individual,—and this is all the difference there is between a politician and a physician,—my diagnosis is that a serious organic state febrile, fitful, fatal, exists in this part of the nation; that it demands the watchful consideration of all physicians, State and ordinary; and that the sooner the natural cure for it, pure air, and plenty of it, is let in the better for every class everywhere.

All political troubles have a physiological cause. To the Statesman not less than to the physician, physiology is the only true source of knowledge. A society such as ours, therefore, possessing as it does professed physiological skill, may render most important service by tracing out for the legislator the simplest scientific means for removing with atmospheric impurities and by preparing for that sanitary future when men universally shall breathe purity even with their freedom.

If any other incentive to action in this direction were required it would be the further fact that all diseases, mental and physical, national and individual, begotten of an impure atmosphere, are transmitted on. The consumption of body, the restlessness of mind are reproduced and gain intensity of development with each generation until practically they inaugurate a distinct racial type of human imperfectedness.

With this topic of legislating for pure air would come in naturally the question of homes for the people and the development of those recent acts which have been passed to meet the necessity. These efforts of the world political can scarcely be over-estimated; but there is one movement which stands before them and which has been singularly overlooked. It is essential that the home of the working man should in every case be cleared of the details of daily work. So long as he is compelled to work in the room in which he sleeps and takes his food, so long his home must be an unhealthy centre, and too often it will be the centre from which infected work will pass out, bearing infection into the homes of the wealthy. A modification of factory legislation by which a free and properly regulated work-room should be within the easy reach of every working man in every crowded centre is a necessity which all sanitary labourers should strive to get supplied. Our Institute has another urgent task before it in the effort to enforce this necessity on public attention.

In the future of sanitary science one more amongst many other reforms of a political character must needs claim important consideration. I refer to the political assistance that must be given to all of us who are engaged in the labour of quenching the drunkenness of our land. Our best sanitary efforts will fall far short of their deserts until this object shall be achieved. Over the future of sanitary science will be suspended a pall of sorrow until this object shall be achieved. Does any one desire to know how the mortality of the kingdom is modified by strong drink, let him read the knowledge in the State record book which tells that those who sell the destroyer die by it at the rate of one hundred and thirty-eight to the hundred of the whole population. Then, starting from this signal fact, let him trace the influence of the destroyer through all the courses of diseases which, under learnedly obscure names, spring from it and kill from it in all classes of society. Finally, let him reckon up the hereditary evils which are engendered by the same destroyer and the influence of that on the course of disease, and his lesson will be in some measure complete.

I do not think this the occasion to discuss the value of the different political sanitary measures that have been, or are at this time, in the public mind for the repression of the national evil now touched upon. Be it sufficient for me to state two impressions only. Firstly, that every day's experience of the question in various communities where as a teacher of abstaining temperance I am wont to labour, indicates to me that unless the State does come to the aid of the teacher the battle against intemperance must be indefinitely prolonged. Secondly, that if the State, itself doing nothing active in the way of repression, would but determine to cease to legalise the cause of the evil and to make revenue out of the transaction, the labours of the temperance reformer would have the most prosperous season of success presented to their view. Hitherto this has not been considered as a sanitary question. In the future no sanitary student will venture to exclude it from his studies.

The contemplation of the political sanitary future of this kingdom offers many other topics, all of which I must

leave, in order to devote a few minutes to our subject in its relation to medical science.

The Medical Part.

The influence which sanitation will exert in the future over the science and art of medicine promises to be momentous. It promises nothing less than the development of a new era; nor is it at all wide of the mark to say that such new era has fairly commenced. The greatest of the world's philosophers, the philosopher whose thoughts cover the world of science as with a garment, I mean Lord Bacon, said of the medicine, of his day, that it stood for judgment on quite different merits than did other learned pursuits. "Other arts and sciences," he argued, "are judged of by the power and ability exhibited in the conduct of them by their professors, and not by success or by events. The lawyer is judged by the skill of his pleading, not by the issue of the trial; the pilot by his skill in directing the course of the ship, not by the fortune of the voyage. But the physician can perform no particular act by which his ability can be directly demonstrated, and therefore he is principally judged by the event, which is very unjust. For who shall decide, if a patient die or recover, whether the good or the evil is brought about by art or by accident? Whence," says he, "imposture is frequently extolled, and virtue decried. Nay the weakness and credulity of men is such, that they often prefer a mountebank or a cunning woman to a learned physician. So the ancients made Esculapius and Circe brother and sister, and both children of Apollo. Hence," he adds, "physicians say to themselves in the words of Solomon, 'If it befall to me as befalleth fools, why should I labour to become more wise?' And therefore one cannot wonder that they commonly study some other art or science more than their profession, because they find that mediocrity and excellency in their own art makes no difference in profit or reputation; for man's impatience of diseases, the solicitude of friends, the sweetness of life, and the inducements of hope, make them depend upon physicians with all their defects."

Had Bacon spoken these sayings in the present day, he had spoken, with one or two exceptional errors, as truthfully as he spoke in his own time. Had he been a physician, he might indeed have gone further than he did. He might have urged his too frequent inadequacy himself to decide whether his own success rested, in particular instances, on skill or on accident. He might further have added how oftentimes the cheek of the right-minded physician pales or burns with doubt as he hears his own praises declared for skill which he himself cannot for a moment take credit to his own heart. This has been the fate of medicine until our day. On such fate all the quackeries have flourished; on it all the "pathies" and dogmatic systems of medicine have flourished; on it the idea of cure has found too willing acceptance and belief.

At last a change has come over the science of medicine. With true nobleness of purpose, true medicine has been the first to strip herself of all mere pretences to cure, and has stood boldly forward to declare as a higher philosophy the prevention of disease. The doctrine of absolute faith in the principle of prevention indicates the existence of a high order of thought, of broad views on life and health, of diseases and their external origins, of death and its correct place in nature. The doctrine of absolute faith in curative medicine, of power vested in the hands of a distinct sect or class, and exercised by them as by regal right and without the assistance or interference of those upon whom it is exercised, indicates a low standard of knowledge; a too confiding spirit in the wisdom of a minority; a departure too wide from the safe law of self-preservation; and an ignorance of the avoidable causes of diseases; a blindness and therefore an unnecessary exposure to danger; an overweening and sudden fear of dangers of all kinds little and great, and a hasty and thoughtless pursuit after that mode of rescue from dangers of disease which claims for itself the greatest pretensions and boasts the greatest successes.

It shall remain as one of the glories of medicine that she herself has first seen these truths, and, willing to sacrifice her own interests to truth and light, has put them forward without fear, without reward. In the science of prevention medicine takes in fact all the world with her. The science becomes a political, a social, as well as a medical study. It appeals to every mind. When it once is so set forth it fills all men with its teachings. It models itself into household truths and commingles with the moral and even religious elements of life. Admitted for a season into the household, it steps forth again to find its way into the legislature. It becomes eventually a governing science—a law.

This scientific course commenced, must needs go on. But in its going it must needs also change greatly the old face of medicine, and remove in the change the Baconian reproach. I do not think there is much difficulty in foreseeing what in the main the change will be like.

I need not say that the "pathies" will go. The pathies of all kinds are as dead as door-nails, and wait only to be decently interred in a common grave. In time the word cure will go altogether. It is clear already that there is indeed no such thing. A man born to live through a given cycle lives through it free of disease, unless he be stricken from without. If he be stricken, and by the stroke the natural functions, by the exercise of which he lives, are not so disturbed but that they can swing back again in due order, he may recover; if he be stricken beyond this, he will die. Nature will pursue her course undisturbed by either event. She will make no special effort to kill, and assuredly she will put out no special hand to save. A man may intervene, and may, by knowledge, put the stricken body into such a condition that it may swing back into natural course whereby he will have put it into a condition in which it will not die. This is the very highest development of medical art resting on science. But it is not cure, in the common meaning of that term.

By the progress of sanitary science and by its influence on practical medicine we shall attain these perfect rules of management after the infliction of the stroke of disease; and I do not doubt that the art of placing the stricken under such conditions that they may not die will for ever afford scope for the inventive genius of man. The more immediate triumphs will, however, come in that part of the work which is purely preventive. Down from the skies comes the forked lightning and lays a man prostrate. It is a question for the ages who shall place that man in a condition under which he shall certainly swing back again into life. But the preventive art that puts up a metallic rod to divert the lightning from other men, that is the present triumph of human skill; skill which, carried to perfection, shall prevent the stroke and put out the second art by removing the necessity for its application.

With the progress of sanitary science we must expect to see preventive medicine taking the ascendancy. Cure will cease, prevention will grow. Humanly-made epidemics, like the great plague of London, which was planted and reared in the rush-covered floors of domiciles saturated with the organic refuse of years, or like the modern typhoid, which is fed by streams of drinking water uncleansed from human excreta, such self-made epidemics will be prevented by simple mechanical skill. Diseases imposed by indulgence in harmful pleasures and appetites, or by physical overwork and shock, will be removed by the effect of moral influences and knowledge of cause; and gradually, I believe, those persistent evils, which, like the lightning-stroke, come without human ordinance or fault, will be placed also under some pro-

tecting care, and, if not removed, reduced to a short calendar.

It is felt by some that the medical Sanitarian of the future will have his best efforts thwarted by the forcible excess of life beyond the means that can be found for the support of life, as if life were a mere secondary principle in the universal order. I see no such cause for fear. That in the progress of life on the earth the day will ever come when the earth will not supply food for its people is to my mind pessimism carried into an insane vulgarity. It is clear that man can always reduce to his wants the lives of all animals except man. The question rests therefore on the abnormal increase of man alone. Nature knows that and rules accordingly. Let man remain savage, and, however sensual he may be, he will die fast enough by war, plague, famine, or luxury. In that state he will never overstock the earth, but either grope in solitary places a neglected family, unprotected from all the killing vicissitudes, or will sink into luxurious barbaric decadence. Let man become exalted in life; exalted by communion with noble pursuits; with pursuits of science, art, letters, and cultivation of greatest happiness for the greatest number, and his sensual life will become too subject to the virtue to leave a chance for the danger which a low sensuality sets up as a terror and at the same time a temptation for the vulgar.

I think it my duty to deal plainly with a question which affects so closely the future of sanitation, and to express, from an experience which is confirmed, as I know, by some of the brightest ornaments of my learned profession, that nothing is wanted to correct the danger of over-population but improvement of mental process; nearer communion with the eternal mind in His works; purer artistic education, healthier homes, more rational amusements, and the ennobling influence of a holier life amongst those who assume to be the cynosures of the nation.

On the whole the prospects of medical learning and action will be greatly improved by sanitary advancement. It is possible that fortunes or reputations resting on faith in famous curers will dwindle slowly away, and that not for long will the skill of the physician be valued by the fallacious reckoning of mere results. But in exchange there will be opened to the physician a career in which skill of labour will be exhibited together with results, the results obvious as to their relation to the work, and both, if good, successful beyond praise.

The Social Part.

The future of sanitary science in relation to social life generally, its effect that is to say on all classes of the community, promises steady progress. No one who has been actively engaged for the past quarter of a century in sanitary work can doubt this statement. Throughout all sections of the community there is desire to know; and if the legislator will be content not to legislate until he sees that free-will guided by knowledge is in the same train with him—it doesn't matter in which class,—all will go well. The workers in our Sanitary Institute though they be not legislators can, nevertheless, greatly assist Parliament by bringing free-will into harmony with knowledge, and though the distinction does not at first sight stand out, in separating free-will from ignorance and from those automatic demonstrations of ignorance which are the outward and visible signs of unhealthy habits of life.

The social work that has to be carried out for the future of sanitary science is purely educational. Educational not merely by lectures and books and lessons from books, but by demonstrations of sanitary works, plans, buildings, mechanisms, results of all labours bestowed on the cause. Without venturing on details of this kind which would land me in another address, I may be content to touch on two points, both of vital moment for the future.

The first of these relates to modes of teaching so as to carry the sympathies of the learner and his more refined tastes along with his reason; to attract and charm his senses as well as his intellect. It is said of us sanitarians, and sometimes I fear with some truth, that we would make health hideous. We need not do so; and if the feat has ever been accomplished it is but the work of a "'prentice han," that ought to be forgiven. Health truly is beauty in the living evidences of it, and should be so in those inanimate evidences which the builder and the engineer construct for us. I would therefore urge that in all coming sanitary work, theoretical or practical, the sanitarian should call the artist also to his side, and that no design of a sanitary kind should ever be executed in which the hand of the artist does not play its beautifying part.

And if I might suggest so much to the imaginative scholars who live to make life sweeter to the many, I would ask them,—poets, painters, sculptors, players, musicians,—to believe that to render practical even their refined labour is to render that labour more acceptable, more diffusible, more durable.

The second topic relates to those who require first to be taught the sanitary lessons of the future. I want strongly to enforce that it is the section of the nation which Dr. Farr classes as the domestic, the six million of women of the nation, on whom full sanitary light requires first to fall. Health in the home is health everywhere. Elsewhere it has no abiding place.

I have been brought indeed by experience to the conclusion that the whole future progress of the sanitary movement rests for permanent and executive support on the women of the country. When as a physician I enter a house where there is a contagious disease, I am, of course, primarily impressed by the type of the disease and the age, strength, and condition of the sick person. From the observations made on these points I form a judgment of the possible course and termination of the disease, and at one time I should have thought such observations sufficient. Now I know them to be but partly sufficient. A glance at the appointments, and arrangements, and managements of the house is now necessary to make perfect the judgment. By this is shown what aid the physician may expect in keeping the sick in a condition most favourable for escape from death; and by this is also shown what are the chances that the affection will be confined to one sufferer or distributed to many. As a rule to which there are the rarest exceptions, the character of the judgment is hereupon dependent on the character of the presiding genius of the home,—on the woman who rules over that small domain. The men of the house come and go; know little of the ins and outs of anything domestic; are guided by what they are told, and are practically of no assistance whatever. The women are conversant with every nook of the dwelling, from basement to roof, and on their knowledge, wisdom, patience, and skill, the physician rests his hopes. How important, then, how vital that they shall learn as a part of their earliest duties, the choicest sanitary code. How correct the decision of the founders of the Sanitary Institute, that from the first they should include sanitarians of both sexes as working associates.

To women more than to men this work is new. To women more than to men this work is hard to realise. Naturally more conservative than men they are moved with less haste to tasks of reformation and reconstruction. More sensitive to criticism than men, they are given, at first, to resent, as if it were an insult to past customs and usages to which they are attached, the suggestion of innovation. But these passing difficulties removed, there is in the hearts of women such matchless generosity, such overpowering love for every device tending to promote the happiness of all things of life, that we sanitarians may indeed be content for the future of sanitary science in its social aspects, if we do no more than win them to our cause and entrust its details to their ministering spell.

PERU[1]

STUDYING in Mr. Squier's new work the records and ruins which attest the civilisation of Peru before the Spanish Conquest, one finds oneself repeating the often-asked question, Did these advanced arts and institutions arise out of native savagery, or were they at least developed under the guidance of ideas imported from the Old World? Mr. Squier holds that they were indigenous, and his opinion (which is that also of Mr. Markham) must have great weight, not only from the minute care with which he has examined the ruins during his two years' exploration, but from his familiarity with the Spanish literature on the subject. Some readers, however, like the present reviewer, while admitting that much of the Peruvian culture has such a stamp of peculiarity that it must be home-made, may not feel quite so certain of the whole being absolutely free from foreign influence. It is much to affirm of a bronze age people like the Peruvians (for particulars and drawings of their somewhat special types of bronze implements, see pp. 175, 579) that they invented this alloy independently. For an excellent case of mingled native originality and similarity to Old World types, attention may be called to the stone-circles of Sillustani, as exemplified by Fig. 1, reproduced from Mr. Squier (p. 384). He calls them "sun-circles," which, however, is begging the question of their as yet unproved purpose. At any rate there they stand, circles of erect unhewn stones like the cromlechs of Europe and Asia, but with a special feature in the surrounding pavement or "platform" of well-fitted hewn stones, with a gutter running all round the circle near the inner edge.

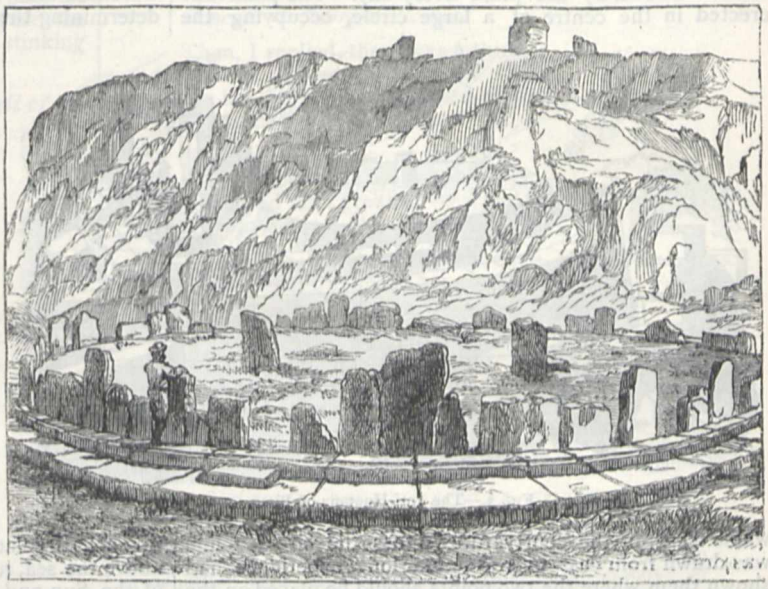


FIG. 1.—Sun-Circle, Sillustani.

On the hill above are seen the ruins of chulpas or burial-towers. Fig. 2 shows two of these, the left-hand one being a beautiful example of building in close-fitting blocks of hewn-stone, an art which had attained in Old Peru to a perfection hardly reached elsewhere in the world. This tower is thirty-nine feet high, and widens as it rises from sixteen feet at the base to nineteen feet at the spring of the dome top. In a still larger chulpa there are hewn trachyte blocks as large as twelve feet long on the curve of the face, by seven feet high, and five feet deep. The stones, fitting together face to face without mortar, are imbedded within in the mass of the structure, which is of rough stones laid in clay. Extraordinary skill in masons' work is shown by these blocks being not only cut in the sides and outside curvature to a radius from the centre of the monument, but in the gradual swell of the structure as it widens out, as well as the curve of the dome, being accurately taken in each block (p. 382). The blocks were not shaped after being put in position, as is proved by numbers of them lying on the ground, perfectly cut to conform to their places in towers that were never finished, so that they were hewn to plans in which every dimension of the structures had been previously fixed. Yet with all this skill there was not the mechanical knowledge to provide anything like pulleys or cranes to hoist the heavy blocks into their places. The inclined planes of earth and stones built up against the chulpas still remain, up which the stones were moved, probably with levers, and possibly with rollers also. Looking at the woodcut, one sees a low opening cut through a block at the base of the tower, just large enough to admit the body of a man; this leads into the circular burial chamber, vaulted with flat, over-lapping stones. This primitive arrangement of the "false arch," which reminds one of those which children make with their bricks, is usual in Peruvian as in Central American architecture. Yet, as if to complicate the problem of architectural history in America, there are exceptional cases where, as at Pachacamac, true arches of sun-dried bricks are still to be seen (p. 71).

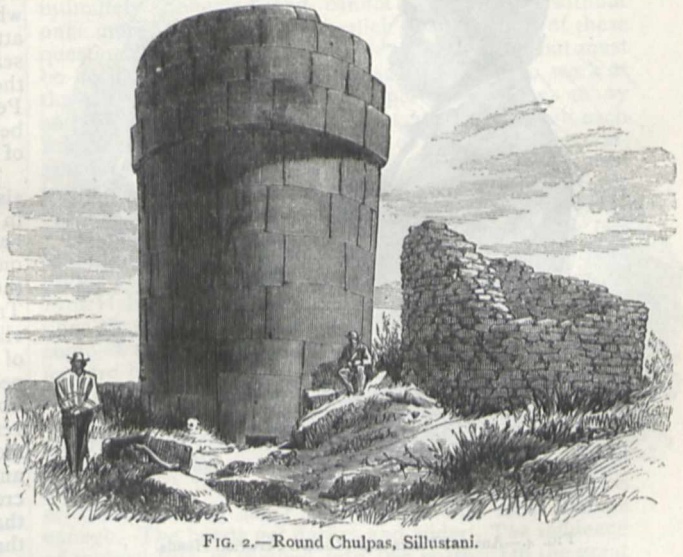


FIG. 2.—Round Chulpas, Sillustani.

Of the more usual Peruvian masonry, where the blocks, accurately faced, are kept in position by their mere bearing on one another, without cement or mortar of any kind, Fig. 3 presents a specimen. It is interesting for other reasons, being one of the Ynti-huatana, or "sun-years," by which the solar year was determined. The following passage from Garcilaso de la Vega's "Royal Commentaries of the Yncas" seems to describe structures of this kind:—

[1] "Peru. Incidents of Travel and Exploration in the Land of the Incas." By E. George Squier. (London: Macmillan, 1877.)

"The Yncas were also acquainted with the equinoxes, and observed them with great solemnity. . . . To ascertain the time of the equinox they had a stone column, very richly carved, erected in the open spaces in front of the temples of the sun. When the priests thought that the equinox was approaching, they carefully watched the shadow thrown by the pillar every day. The pillar was erected in the centre of a large circle, occupying the whole width of the courtyard. Across the circle a line was drawn from east to west, and long experience had shown them where the two points should be placed on the circumference. They saw, by the shadow thrown by the column in the direction of the line, that the time of the equinox was approaching; and when the shadow was exactly on the line from sunrise to sunset, and the light of the sun bathed the whole circumference of the column at noon, without any shadow being thrown at all, they knew that the equinox had arrived. Then they adorned the pillar with all the flowers and sweet herbs that could be gathered, and placed the chair of the sun upon it, saying that on that day the sun with all its light was seated upon the pillar" (Markham's translation, published by the Hakluyt Society, vol. i. p. 179).

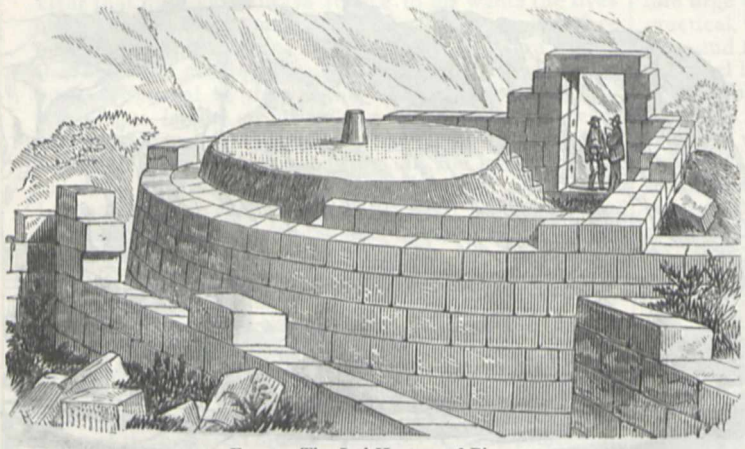


FIG. 3.—The Inti-Huatana of Pisac.

FIG. 4.—Ancient Vases and Modern Peruvian Heads.

It is true that a "stone column very richly carved" seems an inappropriate description of the plain truncated conical gnomon shown in the drawing. It is, however, as Mr. Squier says (p. 525), "sharply cut and perfectly symmetrical." Can this be all that Garcilaso meant by "columnas de piedra ríquisimamente labradas"? or were others of these structures furnished with more ornament? Garcilaso also describes towers near Cuzco erected for determining the solstices; but Mr. Squier considers that his account is confused, and that these so-called towers were only Ynti-huatanas. From this opinion Mr. Markham, writing in the *Academy* for May 19, quite dissents, and probably most readers who go through the whole of Garcilaso's chapter will consider that he had some idea of what he was writing about, and will take it on his (and other) evidence that the Peruvians had, in fact, solstice-towers as well as these equinox-cones. After all one must admit, with Mr. Squier, that the Peruvians had not advanced so far in astronomy and computation of time as the Mexicans and Central Americans.

No traveller before Mr. Squier had thoroughly explored the great lake of Titicaca with its sacred island, celebrated in tradition as the place whence Manco Capac and his sister-wife Mama Ocllo, children of the Sun, and first of the Yncas, came down to govern and civilise Peru. In this cold desolate region, twelve to thirteen thousand feet above the sea, ruins of palaces, convents, and the temples of the Sun and Moon still remain to attest its sanctity under the Ynca rule. Mr. Squier's estimate of the true value to be placed on the traditions of the Yncas is reasonable and moderate. To the warlike genius which enabled them to subjugate the vast land, to the political genius with which they organised the system of communication and social control, which is one of the most wonderful phenomena in the history of nations, he does full justice without countenancing the absurd idea that the whole development of Peruvian culture is to be attributed to this one conquering tribe. His researches, indeed, bring out more clearly than ever the distinctness of much of the native civilisation of Peru from that of the Yncas, whose rule had not been extended over the whole land till near the time of the Spanish Conquest.

The ruins of the temple of Pachacamac, and elsewhere near Lima, show us a people similar in origin and language to the Yncas, but who had their nationality and culture before the conquering tribe came down upon their coast from the high valleys of the Andes. The Chimus of the Truxillo district spoke a language still known in some villages, and said to be quite distinct from the Quichua of the Yncas. Yet these people had attained to peculiar skill in metal-work and pottery. Indeed from this district come the well-known Peruvian vessels with double spouts or double bodies often modelled in the form of an animal or a pair of animals, and with a kind of whistle uttering the creature's proper cry when the vessel is tilted so that the water in it forces air in and out through the hole. Not less curious are the well-modelled head-vases, which (Fig. 4) give us the means of comparing the features of the ancient and modern inhabitants. With reference to this and other drawings here reprinted from the hundreds contained in Mr. Squier's volume, he may be congratulated on the thoroughness with which he has enabled his readers to understand the book which suggested his exploration—Prescott's "History of Peru."

EDWARD B. TYLOR

THE METEOROLOGY OF THE FUTURE

A VISION

FREELY translated from the Japanese by one who is thankful that he does not live in Japan. The translator would remark that in importing our Western institutions it is of great consequence to appropriate likewise the spirit which pervades them. "Dead flies cause the ointment of the apothecary to send forth a stinking savour" (old Eastern proverb).

(*N.B.—This translation is dedicated to the Council of the Royal Society.*)

A QUIET people are the dead,
What stillness do they keep!
The battle rageth overhead,
But marreth not their sleep.

And yet that this is sometimes broke
Hath been revealed to me;
'Twas in eighteen hundred and eighty-one
At the bottom of the sea.

There lay poor Jack, his perils past,
No more to turn the quid,
Nor pipe his eye (since barnacles
Were feasting on the lid).

Long thin sea-ropes in tangled coils
Were round and round him curl'd,
Yea, scaly things above him swam,
Down in that green sea-world.

He could not weigh his anchor up,
He could not heave astern—
And thus in my bewildered ear
He spun his doleful yarn.

"*'Twas not the storm that brought me here*
"*In Davy Jones's grip,*
"*But 'twas because my mates and me*
"*Sailed in a rotten ship.*"

I answered him: But knowst thou not
That Plimsoll's noble band
Board every ship, and punch its ribs
Before it leaves the land.

No rotten beam but would be seen
By such a skilled detector—
The dead man groaned—"*Alas! dear mate,*
"*They jobbed the ship's inspector.*

"*Not two hours' sailing from the Nore*[1]
"*The wind began to veer,*
"*The storm was strong, the ship was weak,*
"*And we were driven here.*"

Belay! belay! thou man of Death,
Thy yarn won't hold together,
Dost thou not know we have a board
That telegraphs the weather?

A board that sits both night and day,
With facts and figures stored,
Why man alive!—The dead man groaned—
"*Alas they jobbed the board.*"

Why dost thou groan thou man of death?
Why so blaspheme and cuss?
Their chairman sure was not the smith
To forge thy fetters thus?

His was a mind of many sides,
Well filled with *a* and *b*,
And *x* and *y*, and likewise *z*—
"*But he didn't know the sea.*"

As thus he spake I forthwith said—
Well, even if this be true,
The captain makes not all the ship,
Now, what about the crew?

There's one I know—"Divine" doth best
Express his god-like presence;
"*He knew the sea but never dived*
Beneath its phosphorescence."

Then, I replied, there was a third,
In fame to none will yield,
He led the band who reaped renown
On India's famine field.

Was he the man to see thee die?
Thou wilt not tax him—come?
The dead man groaned—"*I met my death*
Through a sun-spot maximum."

One more—the rover of the crew—
Hath sailed o'er many seas;
Come now, be reasonable, he—
"*Was busy shelling peas.*"

I wakened up in sheer disgust,
And to myself I said,
The living man for prejudice
Is beaten by the dead.

[1] Of course this word does not occur in the original—only its Japanese equivalent.

THE SPECTRA OF CHEMICAL COMPOUNDS[1]

IN this paper Mr. Moser discusses the question, whether chemical compounds have a spectrum of their own or whether they only show the superposed spectra of their elements. To those who have worked at the subject the question can hardly be called an open one. Ever since the too much neglected work of Mitcherlich it was proved that each compound has its own characteristic spectrum, and whatever evidence subsequent workers have added to the question, the merit of having decided it belongs solely to Mitcherlich.

Nevertheless Mr. Moser's work is a valuable one and for several reasons. Other questions still at issue are intimately connected and cannot be discussed without once more referring to Mitcherlich's work. Most of these questions are not as yet amenable to strict proof but must be decided by the common sense of those who work at the subject. It is therefore of importance that as many as possible should take up the question, and though each worker may add little to the stock of knowledge, the consensus of opinion, thus established, will advance the subject materially. It is a pleasure to find that Mr. Moser has apparently arrived at the same theoretical views which have formed the leading string during the last years to the experimental work of Lockyer and others in this country. Mr. Moser mentions the suggestion of Prof. Helmholtz that the line-spectra are due to the vibrations of an atom while the band spectra are due to the more complex molecule. This is precisely the view first put forward by Lockyer, and it has thus received a striking confirmation from an independent quarter.

Mr. Moser experiments on the changes which certain absorption spectra undergo by a variation first of the thickness of the absorbing layer, and secondly of the temperature. With regard to the variation of thickness of the absorbing layer the conclusions seem simple enough. The bands get darker and wider. The influence of temperature is divided into two parts. On the great majority of bands the increase of temperature has apparently the same effect as an increase of mass; that is, it increases the absorption.

It is more than probable that this increased absorption is really due to an increase in the number of molecules giving the absorption spectrum in question. If a gas is

[1] By James Moser (*Pogg. Ann.*, vol. clx., p. 177.)

near the temperature at which it condenses, its molecules as a rule aggregate before they finally pass into the liquid state. Each molecular aggregation has its own spectrum, and thus a change of temperature producing a difference in the relative number of molecules in these different states will increase the absorption of one spectrum, while it weakens some other absorption spectrum. If the spectrum which gets weaker lies in the invisible part, the only visible effect of temperature is to increase the darkness of the whole observed spectrum. In many cases, however, we can follow out not only the increased absorption of one spectrum, but at the same time the gradual breaking up of another spectrum, and this affords a beautiful illustration of the gradual dissociation which we can now trace step by step.

In order to make my meaning clearer I shall trace in detail the effect of an increase of temperature on the absorption of sodium vapour. If we heat up sodium in an iron tube we observe at first a continuous spectrum stretching from the red and blue end of the spectrum towards the green. If the mass of sodium vapour is sufficiently great the two banks will join, and the whole spectrum will be absorbed. If we now raise the temperature the light will force its way through the bank in the green, and then, almost as suddenly as if a curtain was withdrawn, the spectrum will open from the green towards both sides. The continuous absorption now has entirely disappeared, but a series of finely-shaded bands are seen. The D-line will soon make its appearance, and if we now continue to increase the temperature it will increase in darkness, and we shall soon arrive at a point where the bands quickly fade away, and as we see them disappearing, we see the whole absorption thrown into the D-line, which gets thick and of an intense black colour.

No one who has ever actually observed this fact can for a moment doubt that we have here to do with a real breaking up of the band-molecule, as we may call it, into the simpler molecular state in which it gives the line absorption. Similarly at lower temperatures the band-molecules aggregate and give the continuous spectrum of which we have spoken.

The three vapours which Mr. Moser has examined are: Iodine, bromine, and the oxides of nitrogen. That the darkening of the absorption bands of iodine is due to a breaking up of a more complex molecule is shown by the fact, discovered by Lockyer, that there exists a molecule of iodine which gives a continuous absorption, and which is more complex than the band-molecule. There can be little doubt that this also is the explanation of the analogous phenomenon in bromine vapour. The brown vapour of the oxides of nitrogen are known to be a mixture, and it is, therefore, not surprising that the relative quantity of the different oxides changes with the temperature.

It is, indeed, the second effect of temperature observed by Mr. Moser, that some of the bands disappear as the temperature is raised. There can be little doubt that in the case of the oxides of nitrogen, the three disappearing bands are due to a compound which is broken up as the temperature is raised.

A curious alteration is noticed in the case of iodine and bromine vapour. In each case one band was observed to disappear and to be replaced by a number of fine equidistant lines. I noticed some time ago a similar replacement of a fluted band by a number of fine lines approximately in the same place in the emission spectrum of carbonic oxide. The change requires a more careful study before any decided opinion can be given as to its cause.

ARTHUR SCHUSTER

OUR ASTRONOMICAL COLUMN

THE LATE PROF. SANTINI.—Giovanni Santini, Professor of Astronomy and Director of the Observatory in the University of Padua, whose decease has been announced in the daily journals during the last week, had nearly completed his 91st year, having been born at Borgo S. Sepolcro, in Tuscany, on the 30th of June, 1786. Educated at the University of Pisa, he applied himself especially to the study of the exact sciences, and in 1814 was appointed successor to Vincenzo Cheminello at the Observatory of Padua. He subsequently became Rector of the University and Director of Mathematical Studies, to which position was attached the Professorship of Astronomy.

Santini was the last of a phalanx of distinguished practical astronomers among whom were Argelander, Bessel, Carlini, Encke, Mädler, Struve, and others, which will long live in the annals of the science. The work with which he has been more particularly associated and brought into prominence in the astronomical world, relates to the celebrated comet of Biela, the perturbations of which body were calculated by him upon a uniform system from 1826, when the comet's period of revolution was first determined, to 1859, for which year he prepared an ephemeris, though the track in the heavens was too unfavourable to permit any hope of observations. Santini's memoirs on Biela's comet appear partly in *Memorie dell' I. R. Istituto Veneto di Scienze, &c.*, earlier ones in the *Transactions* of the Academies of Padua and Modena. His colleague, Dr. Michez, took up his work for 1859 and continued the calculation of perturbations to 1866, in which year the comet was sought in vain, and we have no further computation of the effect of planetary attraction upon its motion.

Amongst the other astronomical works of Prof. Santini are several catalogues of stars in the neighbourhood of the equator, or from declination + 10° to − 12°, for the epoch 1840, in which the differences from the positions in Bessel's zones are exhibited. Also an investigation of the mass of the planet Jupiter, from observations of the elongations of the fourth satellite, made at Padua in the first four months of 1835, which gave a result confirming the value deduced by Sir George Airy by similar observations at Cambridge a short time previous, Airy's figure being $\frac{1}{1048{\cdot}69}$ and Santini's $\frac{1}{1049{\cdot}2}$. He was the author of a valuable work for the student, "Elementi di Astronomia," which contains a great amount of information relating to the practice of astronomy, that can hardly yet be said to have become antiquated, though the second and last edition appeared in 1830; the writer of these lines gladly acknowledges his indebtedness to this work, when a student of astronomical methods of observation and calculation, some thirty years since. Santini was elected a correspondent of the Institute of France (Academy of Sciences) in 1845.

THE DOUBLE-STAR 72 OPHIUCHI.—The close companion to this star was detected by M. Otto Struve, with the Pulkowa 15-inch refractor, in 1842. In a note to his catalogue of 1850, he remarks: "I have looked at this star very frequently, and have noted it many times as a single star. On three occasions, however, I have seen it double, always very nearly in the same direction, and at a distance of 1″·5. I do not know how to explain these discordances, except by supposing that the light of the satellite is very variable." In 1847 the angle was measured 166°·3, and the distance 1″·59. Dawes states he had examined the star with different telescopes, including Mr. Lassell's 20-feet reflector, but had never obtained a glimpse of the companion. Secchi thought he saw it double in July, 1857, but placed small reliance upon the observation; in August, 1859, he obtained undoubted evidence of duplicity; the angle was 3°·75, and the distance 0″·604 for 1859-61, magnitudes 4 and 7; he remarks on this occasion: "E certamente doppia, e ben separata." The suspicion of the discoverer is, therefore,

likely to be confirmed when large instruments are brought to bear upon the object frequently.

A REPORTED OCCULTATION OF MARS BY VENUS, A.D. 368, JULY 30.—Amongst the observations extracted from the Chinese Annals by the Jesuit missionary Gaubil, and printed in the *Connaissance des Temps* for 1810, is one which is thus translated: "An 368 = 3e année Tai-ho, 6e lune, jour Kia-yn (30 juillet) Venus éclipsa Mars." It may be worth while to examine how far M. Leverrier's tables will represent this reported observation. Calculating for July 30 at oh. and 8h. Paris mean time, we find the following quantities :—

SUN.

True longitude.	Log. earth's radius-vector.
° ′ ″	
127 10 31·4	0·0045397
127 29 50·7	0·0045058

VENUS.

Geoc. longitude.	Geoc. latitude.	Log. radius vector.
° ′ ″	° ′ ″	
166 25 48 ...	+ 0 30 59 ...	9·860940
166 49 12 ...	+ 0 29 53 ...	9·860966

Distance from the earth at noon, 1·1263.

MARS.

Geoc. longitude.	Geoc. latitude.	Log. radius vector.
° ′ ″	° ′ ″	
166 35 25 ...	+ 0 34 50 ...	0·196730
166 48 17 ...	+ 0 34 37 ...	0·196623

Distance from the earth at noon, 2·2168.

Hence the conjunction in longitude would occur July 30 at 7h. 18·5m. Paris mean time, or July 30 at 15h. 4m. mean time at Nanking, where the Chinese Court was then established; Mars north of Venus 4′ 39″. Consequently, according to M. Leverrier's tables, there would be no occultation, but a very close approach, and considering the calculated time of conjunction, at an early hour in the morning, whereas the planets would be evening stars, it would appear that an occultation was only inferred from some previous or subsequent observations or both. The accuracy of the Chinese record, so far as regards a near appulse of the two planets about the time named, is however confirmed.

THE PREHISTORIC STEPPES OF CENTRAL EUROPE

IN a recent number of the *Magdeburgische Zeitung* is an interesting article by Dr. A. Nehring, upon the former extension of the steppes of Russia into Northern Germany. The country between Magdeburg and Halberstadt now belongs to one of the most fruitful and best cultivated districts in the Fatherland. Yet there are good grounds for believing that in former days this country was for a lengthened period a steppe—probably not an isolated steppe, but connected on the east with the great steppes of Russian Asia.

Northern Germany, including the country designated above, is generally regarded as having been in former times either overflowed by the sea and beset by icebergs, bringing down erratic blocks from the Scandinavian ice-mass, or, as Cæsar and Tacitus subsequently found it, covered with thick forests and extensive marshes. Both these views are correct—the one for what is usually called the Diluvial epoch—the other for the period immediately preceding historic times. Yet we may be allowed to ask what was the state of things in the intervening period? that is, after the sea had left the plains, and before the wood from the neighbouring heights had grown over it. It is probable that the former sea-bottom, which made its appearance as a sandy plain saturated with salt, in many parts of North Germany became a steppe. The same thing has happened in other parts of the world.

A steppe need not necessarily be quite flat. Within the range of the extensive plains of the present steppes and prairies there are not unfrequently hills and undulating or elevated surfaces, and rocks breaking the uniform level. The absence of wood is characteristic; the sandy surface is covered with grasses, dwarf herbs, and stunted bushes, which increase rapidly after the rainy season, but fade away altogether in the dry season, and present the appearance which we generally associate with the word "steppe." The soil is not altogether unfruitful, for the sandy loam is much appreciated by many kinds of plants. It is only where the former sea-bottom consists of pure sand that herbage is altogether deficient. We designate as deserts such tracts of land—especially when they occur in hot countries. The soil of the "steppe" proper is often very fruitful, but its defect is that it has no regular supply of water, being only here and there varied by streams, marshes, and lakes, the latter generally salt. In the neighbourhood of such water a continuous vegetation may be developed, but the greater part of the steppe is covered with herbage for only a few months after the rains, and this disappears as quickly as it grows. Heat and cold, drought and flood, luxuriance and want succeed one another very rapidly.

The fauna of the steppe is, in its most obvious features, quite peculiar. Such of its animals as live on the ground and cannot escape the bad season of the year by emigration, become so accommodated to the climate and soil that they are never met with in other places—that is in woody or marshy districts. Among these the steppe-rodents (such as Jerboas, Sousliks, and Voles) are most remarkable. They find sufficient sustenance in the twigs, leaves, and berries of the steppe-plants. The dry sandy soil is well adapted for their underground dwellings, which protect them from the severe winter and from the attacks of the beast of prey. Let us take, for example, the steppes which lie between the Lower Volga and the Upper Ob. The characteristic animals of this district are (1) the large Jerboa (*Alactaga jaculus*); (2) several species of Souslik (*Spermophilus altaicus*, &c.); (3) the Steppe-marmot (*Arctomys bobac*); (4) the little Piping-hare (*Lagomys pusillus*); (5) the Wild Ass (*Equus onager*); (6) the Saiga Antelope (*Saiga tartarica*). The remaining mammals met with, whether as residents or as temporary visitors, belong either to the fauna of Central Europe or to that of Northern Siberia.

Now this is exactly the same series of mammals which Dr. Nehring's continued researches in the stone quarries of Westeregeln (in the Circle of Manzleben) have brought to light. As regards the number of individuals the steppe-mammals show an undoubted predominance. The most numerous are the Jerboas and the Sousliks, which must formerly have inhabited the neighbourhood of Westeregeln in large numbers. Nearly quite as numerous must have been the wild asses, of which the teeth and bones occur in large masses. There are also many remains of Voles, mostly of such species as at the present time are only found in Eastern Europe and Western Asia. Of the marmot and piping-hare Dr. Nehring has at present only single examples, but expects to find more as his excavations continue.

Of the characteristic steppe-mammals mentioned above the Saiga is the only one not yet found at Westeregeln. But it is to be expected that it will yet be discovered there, because the whole facies of the extinct fauna indicates its former presence, and the Saiga has already been found fossil in several places further to the west. Perhaps also a specimen of a supposed large sheep (*Ovis*), which was obtained some years ago near Westeregeln, may really have belonged to the Saiga.

On the whole, if we put the Saiga aside, the Diluvial fauna of Westeregeln seems manifestly to have been a steppe-fauna, and brings us to the conclusion that the district in which these animals dwelt must have been a steppe of similar character to that which now extends between the Volga and the Ob, and perhaps have been even in direct connection with it. That the animals, the remains of which are found in the Diluvium of Weste-

regeln, actually lived on the plains under the Harz, Dr. Nehring has proved satisfactorily by his own researches. It follows that this country must have formed a steppe during a certain portion of the Diluvial period.

If the above conclusions are right it follows that in a former epoch those parts of Central Europe which were formerly covered by the sea generally became steppes before coming into their present condition. Perhaps the Magdeburg-Halberstadt steppe extended southwards over Aschersleben and Halle into the valley of the White Elster, for Prof. Liebe has found, near Gera, fossil remains of several specimens of the large Jerboa, as also of the Souslik and other animals which have been obtained at Westeregeln. Besides, remains of the same animals, as well as those of the Saiga antelope and wild ass, have been found at several other points to the west. It follows, therefore, that the steppe must have extended considerably in that direction.

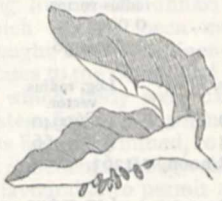
The result of these investigations is the more important as manifest traces seem to show that at the Steppe period man had already occupied the plains of middle Europe, and occasionally took up his abode even on the ancient steppe of Westeregeln.

The cause of the disappearance of the ancient steppes of Central Europe Dr. Nehring supposes to have been the gradual increase of the forests which advanced along with the change of climate. In the Steppe period England and Scandinavia were still joined to the continent of Europe, the North Sea and the East Sea did not exist in their present extent, the Gulf Stream had a more northern direction, and the climate was drier and more severe than it now is. As the climate softened and the forests advanced from the wooded hills, the steppe animals gradually withdrew themselves towards the east, and disappeared, leaving only fossil remains to attest their former abundance.

THE COLORADO BEETLE

WE have already several times referred to this destructive insect, and now that it has reached Europe we give an illustration of the creature in its various conditions, along with some notes which have been forwarded to us by Mr. Andrew Murray. The Board of Trade have reissued the circular, with a coloured illustration, referred to in our article on Our Insect Foes, vol. xv., p. 85.

The Colorado beetle belongs to that subdivision of vegetable-feeding species known as Phytophaga. It may help the general reader to an appreciation of their place and character if we mention the Turnip flea as a British species of this section, and still nearer to it those brilliant green little gems that are to be seen in quantity on the leaves of the white nettle (*Lamium album*) in summer, and which in Scotland bear the colloquial name of Virgin Maries, an appellation, however, which is also there sometimes indifferently given to the ladybird. The genus in this great section to which these little insects equally with the Colorado beetle belong is named Chrysomela. It is true that its first describer, Say, named it *Doryphora decemlineata*, and that at first that designation acquired such extensive currency that it was all but universally adopted; and many people from old habit or deference to general usage, even when they know it to be an error, still use it; but all entomologists know that it is not a Doryphora, but a portion of the great genus Chrysomela, without going into other details. The difference between them can be very easily pointed out by one single character. Doryphora is a massive Chrysomela with a strong spike projecting forwards from the middle (the mesosternum) of the under side, while Chrysomela has no such spike. The former is a genus peculiar to the South American region, including Central America, and contains the largest, finest, and most beautiful species of the family. Some of them are somewhat similarly marked to the Colorado beetle, which no doubt led to Say mistaking the genus. But although the Colorado species and its allies are clearly enough Chrysomelæ, systematists in arranging that genus have broken it up into several sub-genera or new genera, and the latest authority (Chapuis) has placed them in a genus named Leptinotarsa, but at the same time indicates his opinion that a further subdivision must take place, which will leave the Colorado beetle and its relations in a sub-genus by themselves, as was long ago (1837) proposed by M. Chevrolat, under the name of Polygramma. For the characters of these subdivisions we refer to M. Chapuis's genera, and for the specific characters of the species falling under Polygramma to Stahl's diagnosis and Mr. Riley's first



Potato leaf with eggs of Colorado Beetle on under side.

Larva of Colorado Beetle; natural size.—NOTE. The double row of black spots along the abdomen is not sufficiently distinct in this cut.

Pupa of Colorado Beetle; natural size.

Colorado Beetle; natural size.

Magnified Sketch of Colorado Beetle.

Missouri Report (1869). These are, first, the true Polygramma (*Decemlineata*, Say) that has occasioned all this alarm, which is the most northerly species, its native home being the eastern base of the Rocky Mountains and the prairies extending eastward. Next a variety called *Multilineata* by Walsh and Stahl, but which is not specifically distinct. Then a good species, *Polygramma juncta*, which ranges through the Confederate States of North America, and is easily recognised by two of the dorsal black lines uniting to make one thicker one. Farther to the south, about Vera Cruz and Costa Rica, &c., there is another species very like the Colorado species, called *Polygramma undecemlineata*, Stahl, and which is found in enormous numbers in these parts of Mexico. Lastly Stahl records another, which we have not seen, from Mexico, under the name of *novemlineata*. All these feed on different plants, although probably plants all belonging to the same order, the Solanaceæ.

NOTES

THE Society of Arts has awarded its Albert Medal "for distinguished merit in promoting Arts, Manufactures, or Commerce, to Jean Baptiste Dumas, member of the Institute of France, the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts." The Society's Medals for papers read during the session, have been awarded to Prof. Barff, M.A., for his paper on "The Treatment of Iron for the Prevention of Corrosion;" J. Meyerstein, for his paper on "Stenochromy, a Novel Method of Printing in Colours;" A. J. Ellis, F.R.S., for his paper on "The Measurement and Settlement of Musical Pitch;" B. St. John Ackers, for his paper entitled "Deaf not Dumb;" Commander Cameron, R.N.,

C.B., for his paper on "The Trade of Central Africa, Present and Future;" James Irvine, for his paper on "Our Commercial Relations with West Africa, and their Effects on Civilisation;" Sir Douglas Forsyth, C.B., K.C.S.I., for his paper on "The Progress of Trade in Central Asia;" W. Thomson, for his paper on "The Sizing of Cotton Goods."

A CIRCULAR has been issued by Messrs. Rowe and Groser, the hon. secretaries of the British Association Reception Committee at Plymouth, giving some interesting information about that town. Appended to this is a useful table of the tourist fares to Plymouth from some of the principal stations in the kingdom. Besides Mr. Warington Smyth, Prof. Odling and Mr. Preece have been named as lecturers. One of the excursions is likely to be to Exeter; at least the inhabitants of that interesting city are taking active steps to bring this about. Those of the members who were at the Exeter meeting of 1869 have no doubt many pleasant memories of the visit. The fine museum, which was only completed in time for the reception of the Association, is now filled and admirably arranged under the guidance of Mr. W. S. M. D'Urban, F.L.S. The Dublin people have already begun to prepare for the meeting in that city in 1878. A meeting was held in the Mansion House the other day, under the presidency of the Lord Mayor, when it was announced that subscriptions had already been received to defray expenses. Dr. Ball is one of the hon. secretaries.

AT the conclusion of the last meeting of the Royal Astronomical Society, as we stated last week, a special meeting was held to consider a proposed alteration in the bye-laws. The following is a short account of the business transacted:—Before the last election of officers of the Society (in February) two or three of the fellows printed a balloting list of their own, and having circulated it amongst the fellows without any indication of its private origin, many of them used it as a polling paper at the election, under the impression that it had been issued by the Council. The election was also influenced in another way by the putting up for secretary the name of a fellow who had declined to serve. By these manœuvres a curious anomaly in the bye-laws was made effective—so effective indeed that one member was elected to the council by a few votes, whilst another who had obtained a far larger number of votes was ruled not elected. With the view of avoiding such thwarting of the will of the society in future, the council appointed a committee to revise those of the bye-laws which bore upon the subject. The present special meeting was called to consider the proposed alterations, and they were now submitted for approval or rejection. An amendment, however, which was proposed by Lord Lindsay, the foreign secretary, was carried, deferring their consideration until after the next election of officers.

A VERY satisfactory Report by the Savilian Professor of Astronomy, Oxford, as Director of the University Observatory, has been made to the Board of Visitors for the year between June 1876 and June 1877. The instruments all seem to have worked well except the sun spectroscope, which became seriously deranged in the month of August last, and has not yet been reinstated. 426 photographs of the moon (making altogether, to this date, 652) have been taken with the De La Rue reflector during the year; of these by far the greater number appear to be suitable for micrometric measurement. This will be systematically applied so soon as the Observatory is in possession of the costly micrometer now in process of construction by Mr. Simms, and which is to be the gift of Dr. De La Rue to the Observatory. Then will commence the difficult but interesting research relative to the amount of the physical libration of the moon. 259 complete measures of 117 double stars have been taken during this year with the great equatorial. A second set of observations of six of the satellites of Saturn has been completed. These comprise thirty measures of the co-ordinates of Titan, twenty of Rhea, fourteen of Iapetus, fourteen of Dione, twelve of Tethys, and two of Enceladus. The sun's chromosphere had been observed and delineated on twenty-two days. Eight measures of the difference of the R.A of Venus and λ Geminorum, and seven of the difference of declination, were taken at the time of their conjunction. Preparations are being made for observations of the planet Mars at its approaching opposition, with a view to the determination of solar parallax. For this purpose the director has devised a new form of micrometer capable of measuring with the requisite exactness distances to the extent of forty minutes of arc. If this instrument realises his expectations he thinks it may supersede Bessel's heliometer. It may properly be called a *duplex heliometer-eyepiece*. The director suggests the advisability of now printing the Proceedings of the Observatory.

A STATUE has been erected at Nancy by public subscription, to Mathieu de Dombosk, the creator of the Roville experimental farm, and one of the earliest scientific agriculturists of France. He was born at Nancy on July 30, 1777.

THE Prussian Government has ordered Berlin to be connected with Hamburg by a subterranean telegraph, in order to avoid perturbations during thunderstorms, which have been very frequent this spring. Similar measures will be adopted for other large towns in Germany.

M. GAUTHIER VILLARS has published in Paris a volume of logarithms, containing tables for all numbers from 0 to 434,000,000,000 with twelve decimals, by M. Namur, secretary of the École Moyenne of Thuin-on-Sambre (Belgium). This wonderful volume, selling at three francs, has been printed by order of the Royal Academy of Sciences of Belgium.

ON Wednesday, June 27, the Harveian Oration at the Royal College of Physicians was delivered by Dr. Sieveking. The orator vindicated the claims of Harvey as the true discoverer of the circulation of the blood, the merit of which had been last year publicly ascribed by the Italians to their countryman Andrea Cesalpino.

LIGHTING experiments with gramme machines are being tried daily at the Palais de l'Industrie, in Paris. The area of the building is 2½ acres, the elevation of roof 95 feet. This immense space has been lighted *à giorno*, with two electric lustres each composed of six electric lamps. The motive power required is fifty-horse power, and the results are very satisfactory, although it has not been stated whether they are superior to those of the Alliance system, and Jablochkoff electric candle. The Great Northern Railway Company regularly use electric lamps for their luggage room. The Paris-Lyons Railway is preparing an experiment for the illumination of the whole of the large Paris station. All these experiments are conducted with the intention of testing several electric systems, in order to obtain an immense lighting power for the 1878 international exhibition.

TOWN Councils are seldom noted for either their intelligence or their foresight. We are glad to find, however, there is at least one exception, in the Exeter Town Council, who have decided to postpone the purchase of their town gas-works, "on account of the success of the electric light, and the probability of its superseding gas." This is creditable to the Exeter Councillors, who, we believe, have been the first public body in this country to recognise the value of this latest application of electricity. We hope their expectations will be fulfilled.

A ROMAN correspondent of the *Times*, writing with reference to the shower of sand which occurred at Rome on June 22, sends a translation of the remarks of Father Joseph Lais, published in the *Voce della Verità*:—"The rain of sand continued although to a smaller extent, on the 23rd of June, on which day the heavens were deeply overcast. The sand fell in small perfectly spherical masses of about 1-25,000th of an inch in diameter, at a *maxi-*

mum. It would appear that vesicular vapour, by the action of the wind, had cemented the grains of sand so as to form globules, analogously to what we see on a larger scale in the formation of hail. We are entitled to assert this, seeing the speedy disaggregation of these globules into grains of sand, when brought into contact with a little drop of water in the field of a microscope. The fall on the 22nd was so abundant in Rome that from the amount, 0·25 gramme, gathered on an earthenware disc of 30 centimetres in radius, we argue a fall of not less than eight quintals per square kilometre." The correspondent himself writes: "I am by no means satisfied that the rain was of sand and water. The drops on my drawing paper were easily absorbed by a pocket-handkerchief, and left no stain on the paper; but my drawing still bears many stains from drops which apparently I had not touched. Since then I have washed the sky over with them, and have afterwards sluiced the surface of the paper with water from a sponge; yet there they remain. If sand they be, that material appears to have a most unusually tenacious affinity for the paper. If the drops were of sand and pure water I should expect to find that as soon as the water had evaporated, the sand would no longer adhere to the paper and that the spots would no longer be on my drawing."

THE *Melbourne Argus* informs us that on May 11 the tide rose from five to eight feet on the eastern coast of New Zealand, and that at Sydney and Newcastle, on the New South Wales coast, the tide also rose above its usual height, though in a less marked degree. It will be noted that the great earthquake-wave which did so much damage to the coast towns of Peru occurred on May 10, the time of propagation of the wave from Peru to New Zealand being, however, not yet precisely stated.

SIGNOR GESSI, the celebrated African explorer, while proceeding to the Lake District, had all his scientific instruments and baggage burnt.

MESSRS. MACMILLAN AND CO. have in the press, and will shortly publish, a translation of Fleischer's Volumetric Analysis. In this work the author's aim is to systematise the volumetric processes. A general scheme of analysis without previous separation of bases is also a feature of the work. The translation is made by Mr. Pattison Muir of the Owens College. The translator has added a few notes and supplementary methods.

THE latest news from Yeniseisk announces the passage through this place of MM. Wiggins and Schwanenberg, on their way towards the north. Capt. Wiggins goes towards his steamer, which has wintered at Zureika, and after having taken on board the tallow he proposes to export, he will return, *viâ* the Kara Sea to England. M. Schwanenberg proposes to undertake an exploration of the graphite mines of the Yeniseisk district, and to take a cargo of graphite to Europe. There is, however, little hope that this latter project will be realised.

WE are glad to learn from the Annual Report of the New Russian (Bessarabian) Society of Naturalists that this young scientific body has displayed during the past year great activity. The following are the more important papers published by the society:—On the family of ephemerides from the stand-point of the Darwinian theory, and on the metamorphoses of axolotls, by Prof. Mechnikoff; the theory of chlorophyll, by Prof. Wolkoff; the algolic fauna of the Black Sea, by M. Rishavy; on the laws of distribution of electricity on surfaces, by Prof. Umoff. The society has, moreover, carried on a considerable number of scientific explorations in various parts of Russia, and has continued the publication of a cryptogamic herbarium of Russia.

THE application of new materials for paper stock which has occupied so much attention of late seems to have attracted some notice in the Philadelphia Exhibition last year. From Jamaica bamboo was perhaps the most important paper-making plant exhibited. Of the young bamboo stems, which are the best for the purpose, a very large supply, it is said, could be annually, by systematic cuttings or croppings, furnished from plants flourishing in the humid parts of the island. It seems that the American paper manufacturers have also wished to make experiments with bamboo with the view, if possible, of introducing it into the American trade; so that, owing to the proximity of Jamaica to the United States, it is supposed that the supply of bamboo may eventually form an article of trade between the two countries.

THE additions to the Zoological Society's Gardens during the past week include two Pig-tailed Monkeys (*Macacus nemestrinus*) from Java, a Black Leopard (*Felis pardus*) from India, two Argus Pheasants (*Argus giganteus*), a Vieillot's Pheasant (*Euplocamus vieillotti*) from Malacca, presented by Sir Harry St. George Ord, C.B.; a North American Reindeer (*Rangifer tarandus*) from Newfoundland, presented by Capt. Edmund Fraser, 60th Royal Rifles; a Javan Chevrotain (*Tragulus javanicus*) from Java, presented by Mr. William Trent; an African Cobra (*Naia haje*) from the Cape of Good Hope, presented by Mr. Eustace Pillans; a Hawk-headed Parrot (*Deroptyus accipitrinus*) from Brazil, purchased; ten Amherst Pheasants (*Thaumalea amherstiæ*), two Temminck's Tragopans (*Ceriornis temminckii*), twenty Common Boas (*Boa constrictor*), born in the Gardens.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following gentlemen were, on Saturday, June 30, elected, after open competition, to demyships in Natural Science at Magdalen College:—Mr. J. F. Heyes, of Liverpool College; Mr. R. V. Jackson, of Clifton College; Mr. G. A. Buckmaster, of Christ's Hospital and St. George's Hospital, London; Proxime accessit, Mr. A. M. Jackson, Magdalen College School, unattached student. These demyships are of the value of 95*l*. per annum, and tenable for five years from the date of election.

BRISTOL.—The first session of University College terminated on the 30th ult. without any special ceremony of prize-day or commemoration. The result of the work of this the first year must be considered very satisfactory, for in spite of several serious disadvantages, the lateness of the arrangements and appointments of last autumn, and the inconvenience of the crowded temporary premises, upwards of four hundred students have been enrolled. This number exceeds that of the first year of either the Newcastle or Leeds Colleges of Science, or of the Owens College. Lectures have also been delivered at Stroud in connection with the clothworkers' industry in the departments of textile fabrics and chemistry. Prof. Rowley has also delivered a course of lectures in literature at Bridgewater. Most of the courses of instruction only extended until Easter, when several of the temporary appointments expired. In consequence of this arrangement the numbers attending the classes in the third term has not been so great as in the preceding. The chemical laboratory has been in full swing, and evening practical classes have been added since Easter. The only reappointments hitherto concluded are the professorships of chemistry and modern literature, the lectureship in experimental physics, and the assistant lectureship in chemistry. The other reappointments are held over until the election of a principal, which will take place during the present month. It is understood that there are sixty candidates for this important post. No provision has yet been made for a lectureship in engineering.

ST. ANDREWS.—We understand that Prof. Fischer, the present occupant of the chair of mathematics in the University of St. Andrews, has made application to the University Court of St. Andrews for leave to resign his chair on a retiring allowance. As the necessary arrangements will most probably be completed during the present summer vacation, a new appointment will fall to be made before the opening of the session in the United College in November next. The patronage of the chair belongs to the Crown.

TAUNTON COLLEGE SCHOOL.—In reference to our article on Taunton College School, Mr. C. P. Bahin, of Heaton Moor, Stockport, writes that science was taught at that school before Mr. Tuckwell's time. Mr. Bahin forwards us a prospectus of the school for the year 1860, and what position was allotted to science at that time in the school may be inferred from the fact that "Physical Science" comes in as the last subject in the General Department after Fortification, that no mention is made of it in the Classical Department, and that "Monthly Lectures on General and Scientific Subjects are given during the winter season; and in summer, occasional excursions, with a view to the practically illustrating the various branches of Natural History, are taken in one of the weekly half-holidays." This is exactly the state of things we have all along protested against, and which Mr. Tuckwell has managed so successfully to remedy in the case of the Taunton School.

SCIENTIFIC SERIALS

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. x., fasc. ix. and x.—On the equation of the eikosahedron in the resolution of equations of the fifth degree, by M. Klein.—Further notices and observations on the comets of 1877, by M. Schiaparelli.—On the morphological nature of distigma, by M. Maggi.—Case of fracture of the neck and diaphysis of the femur, by M. Scarenzio.—The combustibility of tobaccos, by M. Cantoni.—Stratigraphical observations on the Province of Pavia, by M. Taramelli.—Experimental researches on heterogenesis, by MM. Maggi and Cantoni.—On the relative length of the index and ring finger of the human hand, by M. Mantegazza.

Fasc. xi.—Contributions to the morphology of Amphizonella, by M. Maggi.—On the Arachnida of Greece, by M. Pavesi.—On the tension of induced electricity, by M. Macaluso.—The albuminous matter of urine, by M. Pellogio.—On the relative and specific weight of the cerebellum and the arch of the cranium, by MM. Colombo and Pizzi.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, June 21.—Dr. Gladstone in the chair. The president announced the following grants from the Research Fund of the Society: Dr. Wright, 50*l.*; Mr. Neison, 25*l.*; Mr. C. Williams, 25*l.*; Mr. G. Harrow, 10*l.* The following papers were read: On diamyl, by H. Grimshaw. This substance was prepared by the action of sodium on amyl bromide. It boils at 160°. A chloride and acetate were obtained and investigated. By the action of caustic potash on the acetate, two alcohols were formed boiling at 202° and 212°. On oxidation acids were formed.—On the action at a high temperature of certain volatile metallic chlorides on certain hydrocarbons, by Watson Smith. *a.* The author investigates the action of antimony trichloride, and tin tetrachloride on naphthalin, benzene, and toluene, when these substances are severally passed in the state of vapour through red hot tubes. Benzene and tin tetrachloride gave a very large yield of diphenyl in one distillation. Toluene and antimony trichloride gave oils boiling at 270–320°. Naphthalin and antimony trichloride: 77 grm. of the former yielded 24·2 grm. of yellow crystalline isodinaphthyl; with tin tetrachloride, in addition to a large yield of isodinaphthyl, a reddish oil, and a citron yellow powder were obtained. *b.* Isodinaphthyl sulpho-acids and salts with certain other derivatives; the α and β sulpho-acids were prepared, also an oxydinapthyl, a nitro-substitution product, and a cyanogen derivative. *c.* A new dinaphthyl. In the purification of crude isodinaphthyl by petroleum spirit, a fine red solution was obtained; from this the author succeeded in separating three substances melting at 75°, 147°, and 253°; the latter is probably Lossen and Otto's polymeric dinaphthyl, the second is an isomeric dinaphthyl already obtained by Lossen, the first is a new isomeric dinaphthyl.—On the action of alkaline oxalates on the earthy carbonates, and of solutions of alkaline carbonates on the earthy oxalates, by Watson Smith. The author having observed that when a solution of ammonium oxalate was brought into contact with chalk or powdered marble, an ammoniacal odour at once became apparent, has carefully measured the extent of this and similar reactions.—Note on thallious platinocyanide, by R. J. Friswell and A. J. Greenaway. In 1871 one of the authors stated that the above substance was colourless, but that a compound of it with thallious carbonate crystallised in dark red needles reflecting a green metallic lustre. Carstangen having confused the two substances and stated that thallious platinocyanide crystallised in blood red needles, the authors have re-investigated the question, and fully confirmed the statements made in 1871.—On crystallised barium silicate, by E. W. Prevost. Pisani having stated that this substance crystallises in barium hydrate reagent bottles, the author has examined similar crystals, and finds that they consist of barium hydrate.—A note on anethol and its homologues, by W. H. Perkin. Methylparoxyphenylacrylic acid, when boiled in a bulb tube, furnishes a distillate, consisting of an oil with the formula $C_9H_{10}O$, which on oxidation yields apparently anisic acid. Methylparoxyphenylcrotonic acid yields anethol, methylparoxyphenylangelic acid yields a similar substance.—Note on persulphocyanic acid, by R. W. Atkinson, Japan. The author discusses the constitution of the above substance, and after investigating various silver and mercury compounds, concludes that the formula proposed by Glutz is probably correct.—On the oxidation products of the aloins, by A Tilden, D Sc. Barbaloin and socaloin when oxidised by potassium dichromate and sulphuric acid, yield a yellowish substance, which the author proposes to call aloxanthin, having the formula $C_{15}H_{10}O_8$. This substance, when treated with fuming nitric acid, yields a yellow nitro-acid, having the properties of aloetic acid.

Geological Society, June 6.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—The Rev. Charles Leach, William May, John W. Myers, and John Fletcher Pagen, were elected fellows of the Society. The following communications were read: On the rank and affinities in the reptilian class of the *Mosasauridæ*, Gervais, by Prof. R. Owen, C.B., F.R.S. The author stated that while the Mosasaurians had been originally referred to the Cetacea by Camper, then to Crocodilia by Faujas de St. Fond, and to the Lacertilia by Cuvier, Prof. Cope had recently thought he recognised in them Ophidian affinities, spoken of them as "sea-serpents," and formed of them an order called Pythonomorpha. He then discussed in detail the various characters presented by the remains of these animals. The distinctive characters did not appear to the author to be sufficient for ordinal rank, and with P. Gervais he regarded the Mosasauridæ as a family of Lacertilia equivalent to the Iguanodontidæ and Megalosauridæ in the order Dinosauria. The order Lacertilia among reptiles, being equivalent to the order Carnivora or Feræ among Mammals, the Mosasaurians would be the equivalents of the seals in the latter.—Note on the occurrence of the remains of *Hyænarctos* in the red crag of Suffolk, by Prof. William Henry Flower, F.R.S. The traces of *Hyænarctos*, described by the author in this paper, consist of a right and a left first upper molar, which were obtained from the Red Crag of Waldringfield, and are so much alike, that but for the former being rather more worn, they might have belonged to the same animal. On comparison these teeth were found to show no appreciable difference from the corresponding teeth of the original specimen of *Hyænarctos sivalensis* from the Sewalik Hills, and hence the author did not venture to regard them as representing a species distinct from the Indian one.—On the remains of *Hypsodon*, *Portheus*, and *Ichthyodectes* from British cretaceous strata, with descriptions of new species, by E. Tulley Newton, F.G.S., of H.M. Geological Survey.—On the precarboniferous rocks of Charnwood Forest, Part I., by the Rev. E. Hill, F.G.S., and the Rev. T. G. Bonney, F.G.S. The authors described a mass of slates, grits, and volcanic breccias, accompanied by some knolls and dykes of syenite, spread over a space of about fifty square miles. They showed that the patches marked on the Survey Map as greenstone of Bardon, Birchwood, and Buck Hill, except a very small portion of the latter, are really altered rock; that the syenite knoll of Bawdon Castle carries a mass of breccia in its centre; and that the area of syenite in Bradgate House Woods must be enlarged. Several writers have noticed that part of the porphyritic region of the north-west corner is altered rock. The authors showed that there is in it no igneous rock at all, and that the same is the case with every one of the smaller patches marked as porphyry on the Survey Map. All are volcanic breccias, ashes, or agglomerates, some of enormous size. The extent to which volcanic materials enter into the rocks of the district is remarkable. The authors endeavoured to correlate the stratified rocks, and adduced evidence to prove that the pebble and ash-beds of Forest Gate, the grit and pebble-beds of the Hanging Rocks, the similar beds in the grounds of Mr. A. Ellis, at Swithland, and the quartzites of Bradgate Stable Quarry, Groby Pool, and Steward's Hay Spring, form one horizon; the slate breccias of Blores Hill, Bradgate, Ulverscroft Mill, Markfield, Bardon, and High Towers, a second; the coarse ash-beds of Benscliff, Chitter-

man Hill, Timberwood Hill, and the Monastery, a third; and the quartzose rocks of Charley Wood, Charley, the Old Reservoir, and Blackbrook, a fourth. Hence they showed that the beds are considerably dislocated near the syenites, which removes the main objection which previous writers have urged against these being intrusive; and they described the evidence they have obtained as to this being their real nature. This evidence included the description of actual contacts of igneous and sedimentary rock seen at two points in the wood south of Bradgate House, and at a third in Bradgate Park. They propose, in a continuation of the paper, to touch upon the faults, and to describe in greater detail the microscopic structure of the rocks.

Photographic Society, June 12.—J. Glaisher, F.R.S., president, in the chair.—A paper was read by Mr. J. R. Sawyer on the action of light, temperature, and atmosphere upon pigmented sensitive tissues; showing that when once the action of light had been set up upon the sensitive pigmented tissue (used in carbon work) the same action was *continued* in darkness and exclusion from the atmosphere; by this action an increased power and facility of producing large numbers of the same subject was obtained; as also the possibility of producing different tones of coloured pigments, by this important discovery, which the paper described.—A paper by Mr. Herbert B. Berkeley—notes on the theory and practice of emulsion processes—was read, relating to the use of zinc bromide in emulsions.—Capt. Abney, R.E., F.R.S., followed with a note giving the details and results of his own investigations upon the same subject.—Mr. R. W. Thomas, F.C.S., read a note on the nitrate of silver bath.

VIENNA

Imperial Academy of Sciences, March 8.—On some reactions of amido-acids: on the copper salts of leucin, tyrosin, asparagin acid, and glutamin acid, on the dissolving power of amido-acids for cupric oxide in alkaline liquid, by M. Hofmeister.—On a modification in the determination of vapour densities, by MM. Goldschmidt and Ciamician.—Further experiments on galvanic expansion, by M. Exner. The elongations through the galvanic current were not markedly different from those which would arise from heat developed by the current; the differences did not amount to three per cent. of the whole expansion, and were partly positive, partly negative. Hence the author pronounces against a galvanic expansion.—On the teeth-apparatus in frogs and their larvæ, by M. Wajgel.—Description of a steerable flying machine in form of an eagle, by M. Grois.—The fossil bryozoa of the Austro-Hungarian miocene, by M. Manzoni.—On cosmic vulcanism, by M. Tschermak. He thinks the hypothesis most applicable to it is that which explains volcanic phenomena on the earth by gases and vapours, which have been held absorbed in the supposed liquid interior, but developed in the gradual solidification.—On point systems in rational space curves of the fourth order, by M. Weyr.—On polypes and jelly fishes of the Adriatic, by M. Claus.—On *Sagartia troglodytes* Gosse, by M. v. Heider.—On diffusion of gases through clay cells, by M. Puluj. He finds, *inter alia*, that water vapour diffuses more quickly than air (and here contradicts Dufour's statement that dry air diffuses more quickly than moist). Vapours diffuse approximately in inverse ratio of the fourth root of their densities.

PARIS

Academy of Sciences, June 25.—M. Peligot in the chair.—The following papers were read:—On the heat liberated by chemical combinations in the gaseous state; anhydrous acid and water, by M. Berthelot.—On the equivalent of organic compounds, by M. Berthelot.—On a new anthophyllite of Bamle, in Norway, by M. Des Cloizeaux. Anthophyllite (in this specimen) presents new similarities to amphiboles; like them, it may contain a large proportion of aluminium (twelve per cent.) in varieties of homogeneous appearance, and it has a marked tendency to pseudomorphism.—Reply to observations of M. Mouchez (continued), by M. Villarceau.—On an apparatus called a central obturator-inflamer, capable of adaptation to all cartridges, by M. Cosson. The inflamer is a cylindro-conical case forming an air-chamber, in which the priming explodes; the gases are distributed by slits in the top of it. The obturator is a convex sheet iron shield with serrated border, and a central hole for the inflamer. The combination is placed in the socket of the cartridge, and the obturator then flattened, so as to firmly and hermetically close the base. Among other advantages, it is claimed to improve the range, increase the penetration, diminish recoil, and preserve the cartridge-sockets intact.—H. M. Don Pedro d'Alcantara was elected foreign associate in room of the late M. Ehrenberg. He obtained thirty-nine votes, M. Van Beneden one.—On the state of the vines of Mezel, near Clermont Ferrand, according to a report of M. Truchot, by M. Aubergier.—Anthogenesis in subterranean pucerons of the Gramineæ, by M. Lichtenstein.—On a means of avoiding the resonance of the seventh minor harmonic of the fundamental in the series of grave cords of the piano, by M. Dien. The damper (which is the cause) is allowed to act in its ordinary place, but it moves, simultaneously, a lever having at its upper end a second damper, which touches the cord at a quarter of its length, and causes resonance of the double octave, destroying completely that of the defective triple minor seventh.—Historical remarks on the theory of motion of one or several bodies, of constant or variable forms, in an incompressible fluid, &c. (continued), by M. Bjerknes.—New method of elimination of arbitrary functions, by M. Minich.—On a solar spot observed during the month of June, 1877, by M. Tacchini.—On the 3rd a small spot (the only one) appeared in the east, and gradually enlarged to 40s., by the 7th continuing of this size (some small spots which presently appeared with it ever changing) till it was near the border on the 13th. On the 14th, when projection and photography revealed hardly a trace of the group, the spectroscope discovered very lively chromospheric flames; higher up, several oblique fragments, evidently from violent eruption, eruption flames on the right, and lastly, a nebulous chromospheric mass, well illuminated and slightly divergent. There was constant commotion of matter. The case is cited as against M. Janssen's view.—On a glass of phosphate of lime, by M. Sidot. It is perfectly transparent, very refringent, (index 1·525), can be cut like ordinary glass, is dissolved by oxides of cobalt and chromium, is not attacked by cold acids, but is attacked by boiling acids and by potash, is not attacked by hydrofluoric acid.—On the dissociation of carburets by means of palladium wire, and on the relation of these facts with actions of presence or catalytic phenomena, by M. Coquillion. To analyse carburets with palladium wire there must be enough oxygen to work complete combustion of the constituent carbon and hydrogen.—On the determination of potash, by M. Carnot.—On the nickelised iron of Santa Catharina, in Brazil, by M. Guignet. The bed is now exhausted; it is thought to have been a meteorite with weight not under 25,000 kilogs. (the Ovifak block was 20,000 kilogs., and so was that of Durango, Mexico, found in 1805). The last portions had very little nickel.—Description of several minerals, by M. Pisani.—Reply to objections raised by M. Naudin against the project of an interior sea in Algeria, by M. Roudaire.—Investigation of the free acids of gastric juice, by M. Richet. Pure gastric juice contains almost only mineral or similar acids; organic acids increase when, left to itself, it ferments. Aliments increase by 20, 50, and even 70 per cent., the acidity of liquids in the stomach. The mineral acid continues predominant so long as there is no putrefaction.—On lymph as an agent of propagation of vaccinal infection, by M. Raynaud. The observations are somewhat discordant, but the virulence of lymph from a vaccinated region is demonstrated.—On the pebbles of a hill near Vailly, in the department of Aisne, by M. Robert.

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