THURSDAY, MARCH 2, 1876

THE GOVERNMENT SCHEME OF UNIVERSITY REFORM

THE speech of Lord Salisbury in the House of Lords on Thursday evening, on introducing a Bill for regulating the reform of Oxford University, will probably satisfy the expectations with which the declaration of the Government policy has been awaited. It is a fortunate circumstance that the conduct of the measure should be placed in the hands of one who is, at the same time, Chancellor of the University, a minister in whom both his party and the country have entire confidence, and also a well-known friend of the physical sciences. The Government scheme, therefore, is introduced under favourable auspices; and, in itself, so far as it has been yet revealed, it seems calculated to disarm all opposition. It is true that much yet remains to be learned concerning the modes in which the scheme is to operate. The names of the Commissioners, to whom a certain degree of control is apparently to be entrusted, will be looked for with anxiety; and the details, which will only be understood when the bill is printed, will also be of much interest to those who will be directly affected by them. But the general public, who are after all the party most concerned, is contented with the enunciation of principles which Lord Salisbury's speech contains. He argued, with great ingenuity, that it is not possible for Parliament to dictate to the University and College authorities the precise lines of reorganisation along which they are to proceed. This argument suggests much that a party critic may object to as involving an abnegation on the part of Ministers of their own proper responsibility. However that may be, it is certain that people at large are totally incapable of giving an intelligent approval to anything more definite than the proposals which Lord Salisbury has sketched. Indeed, it may be doubted whether the absence of complete knowledge to which Lord Salisbury himself pleaded guilty, though it may somewhat surprise and disturb Oxford residents, will not have the effect of bringing him into closer harmony with the general feeling of the country. The case for reform does not rest upon minor matters of detail which require research to discover and particular experience to appreciate, and of which the meaning might be altogether altered by further research and wider experience. The plain statement of the facts is enough, and upon that plain statement Lord Salisbury has wisely relied.

The collective revenue of the Oxford Colleges, after making certain necessary deductions, amounts to something over 200,000*l.* per annum; and as the number of undergraduates is less than 1,000, it follows that the average income per undergraduate is a little more than 200*l.* a year. It is important that this estimate should not be interpreted as if it meant the average cost of educating each undergraduate, as Lord Salisbury has not sufficiently guarded himself against the possibility of this confusion. The real meaning of the calculation is to indicate forcibly that at the present time endowment is out of all proportion to educational efficiency. Looking at the figures from another point of view, we find that, out of the total endowments, Fellowships of one kind or another take just one-half or 100,000*l.* Of this sum, again, Lord Salisbury estimates that "idle Fellowships," or those to which no duties are attached, absorb from one-half to four-fifths. There is thus left a balance of from 50,000*l.* to 80,000*l.* a year, which is admittedly not devoted to academical purposes. It is important to recollect that this calculation comes to us upon the authority of Lord Salisbury. The late University Commission, rigidly limiting itself to its immediate functions, merely presented a general account of the income and expenditure of the Universities and their Colleges, and did not attempt to estimate the number of non-resident Fellows, or even to suggest what proportion of the endowments were unremuneratively expended. But this large sum is far from being all that University reformers will have to deal with. Lord Salisbury states that there must be added no less than 123,000*l.* per annum, which represents the probable augmentation in the rents of the College estates within the next fifteen years, as ascertained by the Commission of Inquiry presided over by the Duke of Cleveland. A yet further addition is suggested by Lord Salisbury, arising from the appropriation to educational purposes of certain ancient trust-funds vested in the Colleges, which are now misapplied. Of the amount of this latter source of income, it is impossible to give even an approximate guess. Lord Salisbury carefully refrained from hinting at any specific trust; and it is doubtful whether there are, at Oxford at least, any misapplied trust-funds of any magnitude, except perhaps the Hulsean endowment connected with Brasenose College. Lord Salisbury seems rather to have been glad to take the opportunity of stating his views with regard to the general question of modifying old endowments, than to have referred to any changes of practical importance. It is noteworthy, however, that his views entirely coincide with those expressed by Lord Derby before the University of Edinburgh last December; and thus the two most influential members of the Conservative Ministry are found in agreement upon a policy which has sometimes been claimed as the peculiar heritage of the Liberal party. Whatever may come from minor trusts, the whole available surplus of the endowments at Oxford may be fairly estimated at about 200,000*l.* a year. This sum, of course, is not at the present moment ready for distribution; but it is the amount which, allowing for vested interests and the slow processes of change, Lord Salisbury appropriates to the purposes of his scheme of reform.

That scheme itself has only, as yet, been indicated with very vague touches; but enough has been said to satisfy all reasonable hopes, and to encourage us to wait confidently for the filling-in of the details. In the first place, Lord Salisbury proposes to restore to the University, so far as money can do so, her ancient pre-eminence over the Colleges. The demands of the University for buildings and for professors are to be supplied out of the forfeited "idle Fellowships." "It may be wise to maintain a few of these latter, limiting the holding of them to a certain number of years; but I do venture to lay down that all the University wants, in the shape of museums, libraries, lecture-rooms, and the proper payment of teachers, should be provided for, before the subject of furnishing incomes to men who do nothing can be entertained." The second principle enunciated by Lord Salisbury is the endowment of research—a principle which has been long advocated in these columns, but which now for the first time appears destined to obtain legislative sanction. In the case of its distinguished sojourner, Prof. Max Müller, the University of Oxford has already admitted its duties in this matter; and now research in the physical sciences, under the ægis of Lord Salisbury, and with all the authority that Parliament can lend, will put in its claim to be "made a part of the regular and recognised machinery of the University." To many persons this will be thought the greatest novelty contained in the speech, and it is significant that none of the three peers who followed the mover made any allusion to it in their brief remarks. But it is not necessary now to expatiate upon the importance of the proposal, or the valuable results that will flow from it. It is the first fruits of the Royal Commission on the Advancement of Science, and will lead, we trust, to the adoption of more of the recommendations made by that laborious body. It is of more importance on this occasion to call attention to a distinction which Lord Salisbury has apparently drawn, and to which the Colleges would do well to take heed. If we understand his words aright, he would impose upon the University the duty of supplying, of course from the College endowments, the capital sum that will be required "from time to time for buildings and apparatus, necessary for the purposes of research;" while he would leave to the individual colleges "to provide for the maintenance and benefit of persons of known ability and learning, who may be engaged in study or research in the realms of art and science." This distinction seems to us an important one, partly because it assigns to each the functions which they can best perform, with the least revolution in their characters; and still more because it insists upon two separate modes of endowing research, which are of equal value, and must be both demanded alike. We cannot forbear quoting at some length the comprehensive views of Lord Salisbury on this subject:—"We are of opinion that the mere duty of communicating knowledge to others does not fulfil all the functions of a University, and that the best Universities in former times have been those in which the instructors, in addition to imparting learning, were engaged in adding new stores to the already acquired accumulation of knowledge. There are new sciences which have gained, and which are pressing for, admission to the Universities, and I think no one can doubt that it is for the interest alike of the students and of the nation at large that such sciences should have full encouragement. . . . What I am particularly anxious for is that all branches of culture should have equal encouragement, and should be regarded, not as rivals, but as allies in the great and difficult task of cultivating and developing the human mind." Apart from these two leading features of the Government scheme of University Reform—the endowment of the University by the Colleges, and the endowment of Research—it remains only to notice the ease with which Lord Salisbury, in one short sentence, brushes aside "the religious difficulty" as unworthy of attention. "The teachers at Oxford are not clergymen now, and if we want to get the best men, we must get them from other sources than that which formerly supplied them."

With regard to the machinery by which these great reforms are to be effected, it is better that criticism should wait until fuller explanation is given. On a first glance, it would seem that the colleges are to be allowed a year and a half to devise their own schemes of reform, subject only to the approval of the Commissioners. On this point we confess to a feeling of distrust of such "permissive legislation;" and are disposed to adhere to the old-fashioned liberal theory, which had its advocate in the Archbishop of Canterbury. "He believed that the Colleges are not an exception to the general rule which has been found to exist everywhere, that hardly any corporation was capable of entirely reforming itself without external pressure." It should never be forgotten that some colleges have already tried their hands at reform, and that none have yet made adequate provision for the wants of the University or of scientific research. The College which, in all educational matters, is usually recognised as the most efficient, has obtained final sanction to a scheme which does not allude to either of these subjects. Another college imagined but a few years ago that it was reorganising itself in accordance with the most modern ideal, when its teaching staff obtained permission from their episcopal visitor that they might one and all incontinently marry, and bought off his natural opposition by agreeing to retain all the existing clerical restrictions. It is whispered, at the present moment, that a third college has just matured a scheme by which each of the tutors shall receive a fixed salary from endowment of 800*l.* per annum. With these instances in view, it will manifestly be the duty of all sincere reformers to urge that the powers given to the Commissioners should be strong enough to override the possibility of such abuses. If only this be done, and if the name of Cambridge be added to the bill, the Government project will become in all respects praiseworthy.

LEGISLATION REGARDING VIVISECTION

IN our observations last week upon the Report of the Vivisection Commission, we remarked that some might be inclined to think that in the legislative measures recommended Science has made too great concessions to popular feeling, and a more careful perusal of this bulky volume tends to convince us of the correctness of this opinion. One of the most astonishing things referred to in the whole report is the small number of persons for whose restraint the new law is to be passed. Judging from some of the statements made by opponents of vivisection, one would think the vivisectors in this country must be counted by hundreds; but the Commissioners inform us that, on the contrary, not more than fifteen to twenty at the utmost are systematically engaged in the performance of experiments on living animals. They add, however, that experiments are, there is little doubt, occasionally performed by private persons, of whose number they can form no accurate computation. As there might be many such, and their experiments taken collectively might give good grounds for the belief that vivisection is extensively carried on in this country, we have tried to gain some information on this point from the statements of various witnesses. The Society for the Protection of Animals liable to Vivisection has published a pamphlet containing such extracts from the Report of the Commission as tend to justify the position taken up by the Society, leaving the advocates of vivisection, as it tells us in a prefatory note, to give publicity to such parts of the evidence as favour their views. We have selected the witnesses quoted by this Society as giving evidence upon the extension and abuses of vivisection, in order that we might not run the risk of being misled by partial statements and of under-estimating the extent to which the practice prevails in this country.

The first of these, Dr. Acland, observes that the number of persons in this and other countries who are becoming biologists without being medical men is very much increasing; but beyond this statement, in which he appears to have in view professional physiologists rather than occasional experimenters, there is nothing in his evidence to lead to the belief that vivisection is practised to any extent by the latter class. Mr. G. H. Lewes tells us that so far from ignorant people exercising their fancy in cutting up live animals, even medical students are extremely reluctant to perform experiments at all on account of the trouble involved in doing so. Sir William Ferguson states that the impression on his mind is that experiments are done very frequently in a most reckless manner; but when we look for the grounds of this belief we cannot find anything except the accounts given by students of experiments they had seen during lectures. We should have thought a man of Sir William's experience would not have trusted to such hearsay evidence without farther investigation, knowing, as he must do, how students delight to exaggerate and to tell frightful stories of the dissecting-room for the pleasure of seeing their mother's or sister's eyes grow wide with horror at the tale. The evidence of other witnesses shows that such exaggeration must have been practised here, and that no such experiments as Sir William describes have been performed in any medical school in this country. But this witness is of opinion that it is only in laboratories and schools that vivisection is carried on, as in this country surgeons do not employ it for the purpose of acquiring dexterity, and he thinks there is not much amateur physiology. Such evidence from an active opponent of vivisection goes far to show that the number of occasional experimenters cannot be great, and that the practice of vivisection is almost entirely confined to the fifteen or twenty persons alluded to by the Commissioners. Small as this number is, we would have considered it right to legislate if anything like wanton cruelty had been shown to be practised by them; but the Secretary of the Royal Society for the Prevention of Cruelty to Animals admits that he does not know a single case of the sort, and that in general English physiologists have used anæsthetics where they think they can do so with safety to the experiment. Such being the case, it seems to us that the objections raised to legislative interference by several witnesses carry great weight. Those made by Mr. John Simon are especially worthy of consideration, not only on account of his well-known ability and clear-sightedness, but because his official position has given him a better opportunity of becoming acquainted with the working of laws and of forming a correct judgment regarding the probable operation of any proposed bill than other witnesses who are constantly engaged either in the laboratory or with the cares of practice. The opinion he expresses that incompetent experimenters, careless of the sufferings they inflict, do not exist as an appreciable class in this country, is borne out by the evidence we have already referred to, and it does seem hard that physiologists of high reputation and unblemished character should be treated as a dangerous class, and should be licensed and regulated "like publicans and prostitutes under the licensing system;" Mr. Simon considers that it would afford facilities for the persecution of physiologists, and would enable those who are so inclined to hold them up individually to popular odium. That the inclination is not wanting is shown by the advertisements of the Society for the Abolition of Vivisection constantly appearing in the daily papers. In these an attempt is made to destroy whatever medical practice the authors of the "Handbook for the Physiological Laboratory" may have, and by thus reducing their means of livelihood to starve them as far as possible. This is done by representing them as so hardened by their pursuits and so callous to suffering as to be unfit for attendance at a sick-bed; although we learn from the evidence of Prof. Rolleston and Mr. Simon that two of them at least are exceedingly kindhearted men, and the other two have devoted themselves to researches having an unusually direct bearing on the prevention of disease or the alleviation of suffering.

Much and careful consideration is therefore wanted lest in the endeavour to prevent abuses which may hereafter creep into the practice of vivisection of animals we do not afford facilities for the mental vivisection so graphically described in the evidence of Mr. G. H. Lewes, of honourable, kind-hearted and sensitive men, whose pursuits are not merely advantageous to science but productive, as the Report clearly shows, of great benefit, both to the human race and the lower animals. Legislation may still be wanted in the interests of physiologists themselves, not less than of the animals on which they experiment, but what we have said is, we think, sufficient to show that this must be undertaken in no hasty spirit.

MISS BUCKLEY'S HISTORY OF NATURAL SCIENCE

A Short History of Natural Science, &c. By Arabella B. Buckley. (London: John Murray, 1876.)

THE object of this book is, as stated in the Preface, "to place before young and unscientific people those main discoveries of science which ought to be known by every educated person, and at the same time to impart a living interest to the whole, by associating with each step in advance some history of the men who made it."

We are also told that—

"When treating of such varied subjects, many of them presenting great difficulties both as regards historical and scientific accuracy, I cannot expect to have succeeded equally in all, and must trust to the hope of a future edition to correct such grave errors as will doubtless be pointed out, in spite of the care with which I have endeavoured to verify the statements made.

"As the size of the book makes it impossible to give the numerous references which would occur on every page, I have named at the end of each chapter a few of the works consulted in its preparation, choosing always in preference those which will be useful to the reader if he cares to refer to them."

This last sentence fully accounts for the character of the work. We may say at once that we have not read it through. Our readers will probably soon see why. But we may get a good idea of its contents by dipping in here and there. Geologists do not require to break a mountain down into road metal in order to discover its structure. The book is by no means a paste and scissors production; it is evidently the outcome of very considerable mental exertion, not only in reading, but in thinking. But, unfortunately, the author seems to have accepted as equally trustworthy guides some of the best and most authoritative works extant, and along with them some, often of the trashiest, volumes of the popular scientific literature of the day. In several, especially of the earlier chapters, the first class of works is mainly referred to, in others the second; a few chapters are based upon a mixture, consequently the result is extremely curious and instructive, at least to the scientific critic.

As a whole, the work is decidedly superior to any of the popular ones on which part of it is based; though of course, as they have to a certain extent leavened it, it is in many places not only inaccurate, but positively astounding in its misrepresentations. It is quite easy, however, to trace in each case the more extraordinary blunders to their popular scientific source.

Recent British popular scientific works, at least since we have lost such masters as Faraday and Herschel, have, in general, one or other of two marked characteristics. The honest but ignorant man, too ignorant to be aware of his own ignorance, complacently and in good faith writes preposterous nonsense. Our author has wisely let *him* alone.

Other quasi-scientific men are acute enough to know, perhaps even to admit to themselves (but only under the strictest seal of secrecy) their own ignorance. Sometimes they may condescend so far from their pedestals as to seek assistance from those who are really competent to give it, but even then they do not save themselves. The true critic easily perceives by a single loose word or phrase which such writers cannot refrain from adding to the accurate periods of their mentor (if only to save their own consciences on the question of originality) the true state of the case.

When the quasi-scientific writer feels diffidence in asking assistance, he gets out of his difficulty by adopting what has been well called the "cuttle-fish dodge," and bewilders his readers by squirting in their faces a cloud of inky verbiage. Our author has trusted too implicitly to *him*.

Our readers must now have a notion of what seems to us, at least, the character of this book. The style is clear and good, and many of the incidental remarks and comments are happy. The early chapters, referring as they do mainly to subjects little treated by the modern popular science writers, are, as a rule, very much superior to the later ones, and in many places may be not merely passed as satisfactory, but even highly commended. For instance, the discovery of the law of compression of gases such as air, at constant temperatures, is, for once in a popular book, actually assigned to Boyle himself, though even here the pernicious influence of the popular quasi-scientific writers has asserted itself in the unwarrantable introduction of the perpetual Mariotte. There are some very sensible remarks on Werner and Hutton, and we are glad to see that William Smith's geological labours are heartily recognised. But what shall we say of passages like the following?—

"We owe to him [Scheele] the discovery of chlorine; and of manganese, barytes, fluor spar, and many *other earths* whose names I cannot expect you to know."

Or this—

"The determination of nitrogen completes the history of the discovery of those gases of which *fire*, air, and water are composed; but you will have noticed that we have not yet arrived at the new explanation of chemical changes which was to take the place of 'phlogiston.' The fact is that Black, Bergmann, Cavendish, Scheele, and Priestley, were all so cramped by the old theory, that though they discovered the facts they could not make the right use of them. *The* man who did this, and who laid the foundation of modern chemistry, was the celebrated French chemist, Lavoisier."

We have taken the liberty of italicising two words in each of these extracts.

Again, Fresnel "found that [Dr. Young] also had the same idea [interference], and this led to a number of experiments, by which they proved at last that the waves in a natural ray of light do not move *merely* up and down like waves in a pond, but also from side to side; and that when light is polarised this complex vibration is destroyed and the waves of each separate ray move only in one direction." The italics here are in the text!

From the later chapters we make but two extracts; these will, we fancy, be thought quite sufficient:—

"If the water were free [in Joule's paddle experiment for the determination of the dynamical equivalent of heat] it would pass on into the air and we should lose sight of it; but the water is shut in and the force cannot escape, so now it employs itself in dashing to and fro all the little particles which make up the water, and producing the effect we call heat; and as it produces exactly 1° Fahr. of heat by the time the 1 lb. weight has fallen 772 feet, we say that *772 foot-pounds of force equals 1° Fahr. of heat.* You might easily prove to yourself in a somewhat unpleasant way that the force is there; for if you were to go on turning the paddle violently for many hours, and there were no means for the heat to escape, the motion of the particles would be so violent against the sides of the boiler that it would burst."

Here again the italics are not ours; but the whole passage shows clearly that the author has read this part of the subject in works in which scientific terms are used loosely or even inaccurately; while difficulties have been avoided, not explained. For when "we say that 772 foot-pounds of force equals 1° Fahr. of heat" we commit so many and such astounding blunders that it would be altogether impossible to enumerate them them all in such a notice as this.

Let us, however, do what we can in a few lines to point out a few of them. Suppose them put as questions by a teacher employing this work as a text-book.

1. What is a foot-pound of force?

To this question the late William Hopkins, perhaps the ablest instructor whom Cambridge ever produced, would have at once replied, "The old story; the height of King's College Chapel in acres!" When *will* our elementary writers at last recognise that a force may b represented by so many pounds' weight, but *cannot possibly* be represented by so many pounds' weight overcome through so many feet?[1]

2. What is 1° Fahr. of heat?

One might just as correctly ask, "What is 1 oz. troy of time?" We have heard of degrees of temperature, and of quantities of heat, but we are totally unable to conceive what could correctly be designated by 1° Fahr. of heat, though it is clear that it is here used for "the quantity of heat which can raise the temperature of a pound of water by 1° F." But let us proceed to our final extract:—

"If you have understood this explanation, you will have some idea of the theory that heat is altered motion; but to complete the history we require not only to turn work into heat, but also to turn heat into work. This had already been done many years before by a French engineer, M. Carnot, though he did not understand its real significance, but it has now been most beautifully proved by a long series of experiments made by M. Hirn, of Colmar, in Alsace. What M. Hirn practically did was to find out how much heat can be obtained from a ton of coals, and then to find out how much work was performed in an engine by that amount of heat. This was by no means a simple task, for much heat is lost in various ways in passing through the engine; and even when he thought he had allowed for all this, it was found that some of the steam had turned back into water on its way, and thus used up some of the heat. At last, however, when all was carefully measured and calculated, he found that *for every pound of water heated 1° F., enough work had been done to raise a weight of 1 lb. to a height of 772 feet.* This, you will notice, was exactly the converse of Joule's experiment, and proved that exactly as much motion is produced by means of confined heat as there is heat produced by means of checked motion."

This is certainly very novel information. We have hitherto been accustomed to think that "What M. Hirn practically did was [not] to find out how much heat can be obtained from a ton of coals," but to find how much of that heat disappeared by having been actually converted into useful work in an engine.

But enough has been said to show the necessity for the correction of those "grave errors" alluded to in the second extract made above from the Preface.

As to the chronological table with which the volume concludes, and which is carried on to 1874, we would only remark that it would not have been unduly extended if a little space could have been found for even a bare mention of a few such names as Andrews, Forbes, Graham, Stokes, Thomson, and Clerk-Maxwell in our own islands, and a few more like Helmholtz, Foucault, Plücker, and Weber abroad. Surely such names should have been caught at the very first cast of a net whose meshes were found small enough to seize Drebbel, Franklin, Celsius, Reaumur, Fahrenheit, and Humboldt!

HASSALL ON FOOD

Food: its Adulterations and the Methods for their Detection. By Arthur Hill Hassall, M.D. (London: Longmans, 1876.)

THIS book is practically a new edition of the author's former work on "Adulterations Detected in Food and Medicine;" the main difference being, at least so far as the plan of the work is concerned, that in the present volume it has been thought judicious to exclude the articles on drugs, which occupied indeed a very subordinate position in the older one. We cannot but commend the discretion thus shown: unsatisfactory as are many of the processes employed by the public analyst, viewed as methods of precision, none are more so than those applicable to the analysis of pharmaceutical preparations. It is probably to this fact that we must attribute the immunity from the raids of the inspectors which the apothecaries have on the whole enjoyed; otherwise we must assume that a higher standard of commercial integrity prevails with our druggist than with our grocer or milkman, a supposition to which, possibly, the milkman and the grocer would demur.

Despite the omission referred to, the present volume is nearly double the size of the former one; the increase in bulk may indeed be taken as commensurate with the increase in importance which the subject has of late years assumed. The additional matter comprises articles on the Function, Quantity and Preservation of Food, and on the influence of the utensils employed in its Preparation and Storage: on Unwholesome and Diseased Meat; and on Water and its Impurities A considerable quantity of fresh analytical work has been incorporated, and the author has been at the pains to test the greater number of the various methods commonly employed in the detection of adulteration, and in the determination of its amount. In one or two instances, as for example, in the determination of milk-residues, he is scarcely just to his contemporaries. The chemistry on the whole is fairly good; thanks to the cooperation of Mr. Otto Hehner, whose assistance Dr. Hassall freely acknowledges. But we are inclined, in common, we are sure, with those who have attempted to make absolute alcohol, to doubt that this liquid is best prepared by digesting spirit of 90 per cent. with well-dried chloride of calcium (p. 795). It is well known that calcium chloride unites with alcohol to form a compound in which the alcohol plays the part of water of crystallisation, and which is only decomposed with difficulty. Much is said respecting the composition of "fusel oil" and "potato spirit," although neither the author nor his *collaborateur* thinks it necessary to indicate anything with respect to the existence of isomerism in the alcohols mentioned. On p. 676 we see Payen and Chevallier's analysis of hops given: on the following page precisely the same analysis is repeated as indicating the composition of crude lupulin, which we are further informed, amounts in good samples to about one-sixth of the weight of the hops.

The public generally, and Messrs. Allsopp and Co. in particular, will be alarmed to learn that the water used in the brewery of that eminent firm contains 7·65 grains of sulphate of zinc to the gallon! In the face of such a statement it is hardly sufficiently reassuring to be told that "the water is remarkable for its complete freedom from organic matter" (p. 681). The memory of the strychnine "scare" in connection with the national beverage has scarcely died out: we trust that Dr. Hassall will be the first to allay our anxiety as to the existence of white vitriol in our "pale," and "Burton."

A considerable section of the book is devoted to the

[1] We can hardly blame our author for this blunder, great as it is, when we find substantially the same in a recent work by so learned and careful a writer as Guthrie. In § 129 of his "Magnetism and Electricity" we are surprised to read that a body falling to the ground "will, just before reaching the ground, have acquired a MOMENTUM, which is equal to the WORK done in lifting it." The small capitals are ours—and they but faintly express the agony with which we peruse such a passage.

subject of wine and its adulterations; for much on this matter the author is indebted to the valuable work of Thudichum and Dupré. The question of "plastering" meets with due consideration. This time-honoured operation (it appears to have been practised by the Greeks and Romans) consists in adding finely-powdered plaster of Paris, or sulphate of lime, to the must in the proportion of about 40 lbs. of the plaster to a butt of must, with the view of separating out the vegetable acids in the grape-juice, and thereby, in the opinion of our author, substituting "for the healthful and beneficial tartrates, a bitter and aperient salt"—sulphate of potash. The wines more particularly subjected to this process are sherry, port, and certain French and Greek wines. It appeared to Dr. Hassall "that any process whereby the sulphuric acid can be removed and the original tartaric acid restored, and in the form in which it previously existed, namely, as a tartrate of potash, is highly desirable, and would improve greatly the flavour and quality of all wines which had been plastered, and increase very considerably their money value." Accordingly he has devised such a process in conjunction with Mr. Hehner, and has obtained for it provisional protection with the intent to take out a patent: it consists in treating the wine with tartrate of barium, with occasional shaking, for three or four days. "At the end of this time all but the normal quantity of the sulphuric acid of the wine is precipitated as sulphate of barium, while the tartaric acid is restored in exactly the same amount in which it was originally present; this, uniting with the now liberated potash, gives rise once more to the formation of tartrate of potash, the most characteristic saline constituent of all genuine wines." This "deplastering" process may have all the virtues which its authors claim for it, but since barium salts are in the highest degree poisonous, we, at least, should prefer that our sherry retained all its aperient qualities unimpaired, rather than it should be manipulated with compounds of that element.

In reading this book the question has more than once occurred to us: What must be its effect on the non-professional mind—or indeed on the mind of anybody who, with the view of extending his notions of the principles of alimentation, takes it up for an hour or so in the evening? He will find that the water he drinks may be swarming with *Scenedesmus quadricauda*, *Navicula sphærophora*, and numerous other "living organisms," whose names and appearance are equally distracting; he is told that the tea which he adds to it may be largely composed of the leaves of *Chloranthus inconspicuus*, or of "lie-tea," a vile compound of tea-dust, foreign leaves, sand, and oxide of iron, the whole occasionally coated with "Prussian blue, turmeric, China clay, or other white mineral powder." The sugar with which he sweetens the infusion may be infested with the *Acarus sacchari*, which, he is informed, belongs "to the same genus as the *Acarus scabiei*, or itch-insect, than which, however, it is larger, and possessed of an organisation still more formidable." The milk which he adds to it may be "blue" not merely as he is content to believe through the machinations of the vendor, but from the presence of what the author in one place, following Fuchs, calls *Vibrio cyanogeneus*, and in another place *Oidium lactis*, or *Penicillium*. The question whether fungus or vibrio pales into insignificance before the fact that milk of this kind gives rise to "gastric irritation" or "severe febrile gastritis." His bread may contain *Penicillium glaucum*, or *Oidium orantiacum;* or it may be made from flour harbouring *Uredo segetum*, or *Puccinia graminis*, or it may contain the poisonous darnel, the symptoms produced by which, as he learns from a quotation from Pereira, "are two-fold: those indicating gastro-intestinal irritation—such as vomiting and colic; and those which arise from disorder of the cerebro-spinal system—such as headache, giddiness, languor, singing in the ears, confusion of sight, dilated pupil, delirium, heaviness, somnolency, trembling, convulsions, and paralysis." After this, such commonplace sophistications as alum, bone-earth, and mashed potatoes, can have no terrors for him. His butter, as indeed we learnt from a recent case referred to in NATURE (vol. xiii. p. 242), may be made from other products of the cow than milk, and even his modest rasher may have death lurking in its folds in the form of *Cysticercus cellulosus* or *Trichina spiralis*, concerning which he is told that the former finding its way into the intestines, "there fixes itself by its little hooks, and quickly grows, joint after joint, into a tape-worm;" and that the latter is the cause of "frightful disorder, killing about 50 per cent. of its victims in terrible agony." No wonder that some of us make a 'poor' breakfast; the marvel is that so many of us survive the dreadful meal. We can only account for the fact that numbers are known to exist and even to thrive on such food on the supposition that, like physostigma and atropia, the horrible things we eat act antagonistically and mutually obviate evil consequences: a supposition which we commend to the notice of Dr. Fraser; or it may be, and with equal probability, that the 'living organisms' devour each other, like the Kilkenny cats, and leave no trace, not even their tails, behind them. We refrain from recounting the horrors which may await us at luncheon and at dinner. Even Dr. Hassall is merciful; it was with a profound sense of relief and satisfaction that, turning to the end of the book, we discovered, on the strength of numerous certificates published by him, that some articles of food are, as a certain noble lady should have been, actually above suspicion, although, unfortunately, many of these articles rejoice in fanciful names which hardly serve to recommend them to prudent matter-of-fact housewives, doubtless long ago inured to the all-prevalent adulteration. Dr. Hassall no doubt considers himself a scientific man; but there are cavillers who deem it an act of questionable taste that he should have appended to his book a series of advertisements extending over fifty pages, the greater number of which contain reports issued from his "Analytical Sanitary Institution." We are inclined, however, to look on the matter from what is doubtless Dr. Hassall's point of view, that having made existence scarcely tolerable to some of us by the revelations which it was his duty to make, it was simply an act of kindness to indicate how we might eat our daily bread (to ask for which would otherwise be a mockery) in peace and comfort, even though it should consist of Infants' Food and Angostura Bitters. T.

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.*]

Prof. Tyndall on Germs

I AM very glad I wrote to you putting my questions to Prof. Tyndall. It has drawn from him a letter, full of all sorts of hints and prophecies and information and pleasant observations on details with which I had not thought of troubling him; and there is even a delicate bit of flattery for poor me, of whom the Professor knows nothing. It is really quite a gem of a letter, a beautiful example of that "tour piquant" referred to by M. Pasteur, which the Professor gives to everything he touches, and which we at home know how to value as well as any Frenchman. There is only one fault in it, and that is that the Professor, in the exuberance of his kindness, has unfortunately forgotten to answer my modest questions. But why does he liken himself to Horatius, and talk of enemies yet to be dealt with? Horatius did not sing his pæan before going into battle. And how can Prof. Tyndall have any enemies? I thought that scientific investigators were all brothers. I regarded Prof. Tyndall as a brother keeping a bright look out due north, and Dr. Bastian as a brother with his eye firmly set towards the south, while Dr. Sanderson seemed to me to be a remarkably silent brother gazing somewhere about sou'-sou'-west-and-by-south-a-quarter-south.

But to be serious. Briefly put, the situation seems to be this.

Prof. Tyndall has propounded a theory—no mere speculation raising a trifling controversy to be settled privately with Dr. Sanderson or Dr. anybody else, but a momentous theory on which, as he says, "the lives of men depend," and the truth of which it concerns all men to sift. It is not addressed to any scientific coterie, but widely published for the benefit of the outside world, the like of me among the rest.

The theory as propounded stands or falls with the assertion that when, with due precautions, an organic fluid is boiled for a few minutes in a flask, which is then hermetically sealed, it is impossible to obtain bacterial putrefaction.

What Prof. Tyndall declares to be impossible, that Dr. Sanderson declares that he has done.

If Dr. Sanderson is right there is an end of the theory, and the lives of men must rest on some other basis.

If Prof. Tyndall is right, Dr. Sanderson (not to put too fine a point upon it) has blundered in his very careful experiments.

Anxious to know where I should look for the truth, I ventured to ask Prof. Tyndall which alternative he adopted. Instead of helping me out of my difficulty he has responded with a flourish of rhetoric about not crossing swords with Dr. Sanderson. It is plainly from no want of courtesy that Prof. Tyndall has declined to satisfy my curiosity. He can't help being courteous; and to the class to which I belong—simple students who hang upon the lips of Professors for their scientific sustenance—he invariably overflows with courtesy.

I am sure he would have answered me if he could.

Even now I should be grateful (and so I believe would many more of us outsiders) if on second thoughts he should resolve to put his rhetorical sword into the unadorned scabbard of common sense, and kindly try to answer three plain questions:—

1. Does he accept Dr. Sanderson's experiments, and give up his theory?

2. Does he reject Dr. Sanderson's experiments as untrustworthy, and why?

3. Can he suggest any third view which will reconcile his theory with established facts?

Unless Prof. Tyndall feels constrained by his regard for human life to give me a reply, I will not press him to do so, if it would be in the least embarrassing. Only, if there is to be an answer, I hope this time it will be direct to the point. Perhaps, after all, it is not absolutely necessary. Silence is sometimes more eloquent than speech.

Feb. 19 INQUIRER

[This letter was unavoidably delayed last week.—ED.]

The Mechanical Action of Light

IN his recent lecture at the Royal Institution upon the Mechanical Action of Light, Mr. Crookes stated that his investigations into this subject had enabled him to measure the repulsive force of light, and he calculated that the sun's light exercised a repulsive force upon the surface of the earth of 3,000 millions of tons, a force sufficient, he said, to drive the earth into space, were it not for the attraction of gravitation.

Let us look for a moment at this conclusion of Mr. Crookes. Granting that gravitation and a (hypothetical) tangential force cause the planets to revolve round the sun, the continuous action of a repulsive force emanating from the sun and impinging upon the surfaces of the planets, would cause them to spin round upon their axes just as a ball spins round when it is propelled along a resisting surface. This rotation would be in the same direction —right to left—as the revolution of the planetary bodies in their orbits.

But such an explanation of the rotation of the planets upon their axes will not, unfortunately, hold good, as upon this hypothesis their axes ought to be perpendicular to their orbits, whereas, with the exception of Jupiter, the equators of the planets are largely inclined to their orbits. If, then, the rotatory movement of the earth is not caused by the friction of a repulsive force emanating from the sun, it is clear that the effect of the 3,000 millions of tons which Mr. Crookes says continuously press against that half of the earth's surface which is exposed to the sun's rays, would be to retard not only the earth's diurnal rotation, but also its annual movement round the sun. Now there is no evidence whatever of retardation from any such cause, either as regards the earth or the planets with whose movements we are most familiar.

I do not in the least question that under certain circumstances light may repel solid, liquid, or gaseous bodies, and, indeed, if Mr. Crookes' general conclusions be confirmed, it may be found that the rapid extension of the tails of comets as they approach the sun may be due to the repulsive action of the sun's rays. As this force would be inversely as the square of the distance, the effect of the sun's light, acting in a straight line upon the highly attenuated matter of which a comet's tail is composed, would repel it with enormous velocity in a direction opposite to the sun as the comet approached its perihelion.

Manchester, February GEORGE HICKS

Metachromism and Allied Changes

THE laws of metachromism, enunciated by Mr. W. Ackroyd (in his recent paper read before the Chemical Society, NATURE, vol. xiii. p. 298), have an apparent parallel in the order of colours shown by various series of combinations; there being but few exceptions to the following rule, in its application to binary compounds. *Increase of the electro-negative element produces a colour change towards the red end of the spectrum, and* vice versâ. Thus the sub-oxides are generally blue, and the per-oxides yellow; the sub-sulphides white or yellow; and the per-sulphides red.

The examples which lead to this generalization are as follows:—

K_4O blue grey, K_2O white, K_2O_4 chrome yellow.
K_2S reddish yellow, K_2S_2 orange, K_2S_5 liver brown.
K_2Cl blue, KCl white, Na and Rb chlorides the same.
Na_4O blue, Na_2O yellowish white, Na_2O_2 orange.
Cs_4O blue, Cs_2O white.
$(H_4N)_2S_2$ yellow, $(H_4N)_2S_5$ orange yellow.
CeO white, Ce_2O_3 fawn red.
U_3O_4 green, U_2O_3 brick red.
$FeCl_2$ white, $FeCl_3$ brown.
Cr_2O_3 green, CrO_2 yellow green, CrO_3 red.
MnO olive, Mn_3O_4 red brown, Mn_2O_3 brown black.
MnS dark green, MnS_2 brown red.
SnO olive brown, SnO_2 yellow.
SnS blue grey, SnS_2 yellow.
MoO purple brown, MoO_2 dark brown.
MoS_2 lead grey, MoS_3 dark brown.
$MoCl_2$ deep blue, $MoCl_4$ dark red.
W_2O_5 blue, WO_3 yellow.
Sb_2O_3 grey white, Sb_2O_5 pale yellow.
Sb_2S_3 blue black, Sb_2S_5 orange yellow.
Bi_2O_3 yellow, Bi_2O_5 brown.
Cu_2Cl_2 white, $CuCl_2$ liver colour.
PbO yellow, Pb_3O_4 red, PbO_2 brown.
PbS lead grey, PbS_2 red.
Tl_2O yellow, Tl_2O_3 brown.
HgI green, HgI_2 yellow or red.
Au_2O dark green, Au_2O_3 brown.
$PtCl_2$ olive, $PtCl_4$ orange.
$OsCl_2$ green, $OsCl_4$ red.

With fuller information on the rare and unstable compounds, than is to be found in ordinary text books (such as "Miller's Elements"), no doubt numerous other instances might be noticed; these, however, will suffice to exemplify the general law.

With regard to black compounds, I have not included them in the above list, as they only complicate it unnecessarily; the ordinary term *black* being used to describe a very minute amount of any possible colour. It is only when the predominating colour is observed (as blue- olive- red-black, &c.), that the description is of any value. "Brown" is likewise ill-defined in its spectral position, as various tints called brown generally include a small quantity of any colour except blue. Black and brown compounds are therefore inconclusive without a spectral examination of the colour in each case.

The real anomalies to the above law are the following compounds. $CrCl_2$ white, Cr_2Cl_6 violet; $MnCl_2$ pale pink, $MnCl_3$ green brown; As_2S_2 red, As_2S_3 yellow; HgCl yellow white, $HgCl_2$ white; AuI yellow, AuI_3 green. In these five pairs the law is apparently reversed, but they cannot be said to nullify an induction from thirty-five pairs, as enumerated above. A conformity of six cases in seven to a rule is sufficient to establish it as a law, from which the modifying causes have not yet been eliminated.

One or two other cases might at first seem to be also exceptions; but as they are really *salts*, in which the electro-positive of the base is the same element as that of the acid, they are not necessarily to be compared with binary compounds.

In the order of the colours, it will be observed that, in numerous cases, white occurs between blue and yellow compounds; and there is only one instance of a violet compound with more of the electro-negative element than its white connection. As white light comes (in the natural arrangement) between blue and yellow, this order is more in accordance with the spectrum than is the order of metachromism announced by Mr. Ackroyd, in which white occurs before violet.

It may be worth notice that the electro-negative elements (whose increase reddens the compounds) are, on the whole, rather more red and yellow than the electro-positive, many of which are bluish, and even dark blue, as Na.

This order of colours in successive compounds of a series (which might be called taxichromism) was observed by the writer some few years ago, in connection with the spectral order in metachromism; the latter, however, was only traced through a dozen or so, of the oxides, without pursuing the subject farther.

Bromley, Kent W. M. FLINDERS PETRIE

Seasonal Order of Colour in Flowers

I THINK it may be useful to mention, in reference to several letters on this subject in NATURE, that light appears to have no direct influence on the tints of flowers. I quote the following from Sachs's Textbook, Engl. transl., p. 675:—

"As long as sufficient quantities of assimilated material have been previously accumulated, or are produced by green leaves exposed to the light, flowers are developed even in continuous deep darkness which are of normal size, form, and colour, with perfect pollen and fertile ovules, ripening their fruits and producing seeds capable of germination."

W. T. THISELTON DYER

Rainbow Projected on Blue Sky

AN instance of this phenomenon, which is referred to as rare in NATURE (vol. vii. p. 68), occurred to-day, Feb. 22, 4·30 P.M. The sky was almost quite clear and a light shower of rain falling, caused one to look upwards for the clouds whence it proceeded, but the air was uniformly clear near the zenith, though bordering the horizon all round there were some detached cumuli, and a few thin filmy modifications higher in N.E. There were no visible signs of the origin of the falling drops. On turning round to east, a solar bow was seen, for the most part on a background of azure. It was a *complete* bow and moderately intense. Near the vertex it rested on thin clouds, as did the extremities on the horizon, but they had no sensible effect on the phenomenon, for it was observed that as they receded from the upper portion, the bow remained intact and equally bright in all its parts. The arms spanned areas of blue sky. It was very transient, like the shower, and fading rapidly, was gone within 10 sec. after it was first observed. At 4.45 P.M., the left side of an incomplete bow was seen in N.E. on clear sky, except at the lower extremity: no rain accompanied it. It was as evanescent as the first. The weather was very unsettled and showery with low barometer. Thermometer 50°, with brisk wind from W.S.W.—3½ inches of rain had fallen during the previous 9 days.

WILLIAM F. DENNING

Ashleydown, Bristol, Feb. 22

OUR ASTRONOMICAL COLUMN

OLBERS' COMET OF 1815.—The comet discovered by Olbers, at Bremen, on March 6, 1815, and with which his name has been usually associated, belongs to the group, the members of which revolve in periods a few years less than the period of the planet Uranus. The deviation from parabolic motion was remarked independently a few months after the discovery by Bessel, Gauss, Olbers, Nicolai, and Triesnecker. Bessel calculated elliptic elements so early as the middle of May, and was followed by Gauss in June, and the former subsequently investigated, as completely as was practicable at the time, the elements resulting from the whole course of observation and the effect of perturbation in the actual revolution.

When first detected, the comet is said to have been barely visible in a good achromatic, and according to the *Zeitschrift für Astronomie*, was not discernible without telescopic aid at any time; it is, however, upon record that in Russia it was seen with the naked eye. The last observation was made by Gauss at Göttingen, on August 25. At discovery on March 6, at 10 P.M., it was in R.A. 49°·3 and N.P.D. 61°·3, distant from the sun 1·47 and from the earth 1·30, and at Gauss's final observation it was in R.A. 217°·1, N.P.D. 84°·5, distant from the sun 2·10, and from the earth 2·36. Representing the intensity of light at discovery (calculated according to the usual expression $\frac{1}{r^2 \Delta^2}$) by *unity*, a maximum of 1·4 was attained on May 3, and it had diminished on August 25 to 0·16, or one-sixth of that at discovery.

Bessel's determination of the elements of this comet and of the perturbations to the next return will be found in *Abhandl. der Berl. Acad. Mathem. Cl.* 1812–15. His definitive figures are as follow:—

Perihelion Passage, 1815, April 25·99867 M.T. at Paris.

Longitude of the perihelion	149° 1′ 56″
" " ascending node	83° 28′ 34″
Inclination to ecliptic	44° 29′ 55″
Excentricity	0·9312197
Semi-axis major	17·63383

These elements apply to the date of perihelion passage; the longitudes from mean equinox of 1815.

To the above value of the semi-axis corresponds a period of revolution of 74·049 years. The distance in perihelion is 1·213 (the earth's mean distance from the sun being taken as *unity*), and the aphelion distance 34·055; the minor semi-axis is found to be 6·427. The ascending node is situate near the orbit of the planet Mars, and if the actual form of orbit is due to planetary attraction, it is probably to be ascribed to a near approach of the comet to Mars at some distant period. At the other node the radius-vector is 3·81 in the region of the minor planets. The comet, it will be seen, recedes beyond the orbit of Neptune, but near the aphelion it has a depression of nearly 40° below the plane of the ecliptic.

According to Bessel, the mean motion at the instant of perihelion passage in 1815 corresponded to a period of revolution of 27046·9 days, and he found that this would be diminished 824·5 days by the united action of the planets Jupiter, Saturn, and Uranus, thus obtaining 26222·4 days for the actual revolution, and fixing the next arrival at perihelion to 1887, February 9·4. Beyond doubt, however, this date may now admit of a closer determination, and very probably we may soon hear of a further investigation being undertaken. The original observations made at the Observatory of Paris, and those at one or two other observatories in greater or less detail, are in our possession, and will admit of more accurate reduction than has yet been effected; while a more complete computation of the perturbations with the improved values for the masses of the disturbing planets must tend to diminish the uncertainty that at present exists with regard to the possible error of Bessel's determination of the date of next passage through perihelion. If this should fall about 1887, February 9, as he computed, we might expect that the comet would be detected in September previous in the constellation Monoceros; its intensity of light would gradually increase until its nearest approach to the earth (0·5) at the end of the year, when it might be a conspicuous naked eye object in Ursa Major, within 20° N.P.D., and possibly it would be observable till the following May. Subjoined are figures which will enable any reader who is interested in the matter to trace the comet's course more precisely, upon the above supposition as to perihelion passage.

	R.A. °	N.P.D. °	Distance from Earth.
1886, Oct. 2	97·0	83·6	1·90
,, Nov. 1	106·8	78·2	1·25
,, Dec. 1	117·7	61·0	0·72
,, ,, 21	131·1	33·3	0·52
,, ,, 31	151·9	17·3	0·51
1887, Jan. 10	216·8	10·5	0·55
,, ,, 30	272·3	23·2	0·69
,, March 1	278·8	34·2	0·88
,, April 10	265·4	41·4	0·95
,, May 10	245·5	53·0	1·01

MINOR PLANET, No. 160.—A telegram to the Astronomer Royal, through the Smithsonian Institution, notifies the discovery of another small planet on February 25, in R.A. 10h. 16m. N.P.D. 75° 28′; eleventh magnitude.

THE BINARY STAR ω LEONIS.—Dr. Doberck, of Col. Cooper's Observatory, Markree Castle, Sligo, publishes in *Ast. Nach.*, No. 2,078, provisional elements of this interesting star, viz., peri-astron passage, 1842·77; node, 151° 34′; node to peri-astron on the orbit, 122° 54′; inclination, 65° 22′; excentricity, 0·5028; period of revolution, 107·62 years.

SCIENCE AND ART IN IRELAND

IN our number for February 17, we reprinted from the *Times* an article on the proposed action of the Government in connection with the Scientific Institutions in Dublin. That article contained the substance of Lord Sandon's letter which was forwarded both to his Grace the President of the Royal Dublin Society and to the President of the Royal Irish Academy. This letter was laid before the Irish Academy at their meeting of the 14th Feb., and was by them referred to the Council of the Academy. This latter body having in several meetings fully considered the whole subject, submitted to the Academy on Monday evening, the 28th Feb., the following Resolutions:—

"1. That the Royal Irish Academy is desirous of cooperating with Her Majesty's Government in the measures necessary for the establishment of a National Science and Art Museum in Dublin, provided that the independence and usefulness of the Academy be not injuriously affected by such measures.

"2. That, while we consent to the transfer of our Museum to the Government, we think that its arrangement, as well as the purchase of additions, should be done through the Academy.

"3. That, in thus assenting to the transfer of its Museum to the Government, the Academy also thinks that adequate provision should be made for the continued acquisition of Irish Antiquities, which may hereafter be discovered or offered for sale; and that the collection of the Academy, together with such other Irish antiquities as shall be added to it, should be for ever kept apart from Miscellaneous Art collections in the possession of the Government, and be permanently maintained as a Museum of our National Antiquities, no portion of its contents being ever removed from the City of Dublin.

"4. That, considering the position which the Academy has long held, and will continue to hold, as the first Scientific, Literary, and Antiquarian Society of the country, the proportional representation proposed to be given to it on the Board of Visitors (sect. 12 of Lord Sandon's letter), is altogether inadequate; and the Academy further think that no paid official of the Science and Art Department should be eligible to act as a representative on the Board.

"5. That, as the Academy is making a substantial concession in respect to its Museum, there should be provided in the yearly estimates, as laid before Parliament, instead of the several sums now annually voted, a sum of 2,000*l.*, to enable the Academy to discharge more completely its functions as a Scientific, Literary, and Antiquarian body, by making grants in aid of original research, by publishing the results of such research, by maintaining a library specially adapted to assist learned investigation, and by editing and printing ancient Irish Texts.

"6. That the Academy should be accountable, as at present, to her Majesty's Treasury, through the Irish Government, for the sum to be thus voted by Parliament, and should not be subject, in the conduct of its affairs, or the expenditure of its grants, to any control on the part of the Science and Art Department, or any of its officers."

After some discussion the Academy adjourned to the 6th of March, when it is probable that the resolutions of the Council may be adopted by the Academy, and a deputation appointed to confer with her Majesty's Government on the subject.

The Council of the Royal Dublin Society have also, we understand, drawn up a report with resolutions, to be submitted to a special meeting of the Society which is to be held to-morrow.

We hope in our next number to be able to report the resolutions come to by both bodies, and in the meanwhile refrain from making any comments on the subject.

THE LOAN EXHIBITION OF SCIENTIFIC APPARATUS

A MEETING of the General Committee for this approaching Exhibition was held on Thursday last at the Science Schools, South Kensington Museum. The chair was taken by the Lord-President of the Council, the Duke of Richmond and Gordon, the Vice-President, Lord Sandon, M.P., sitting at his side. Many well-known representatives of science were present.

The Lord-President spoke as follows:—

"It gives me very great pleasure to meet you at the expiration of some twelve months since we first assembled to set in motion a plan for holding a scientific exhibition, and I am happy to be able to congratulate you upon the success which has attended your efforts. The exhibition promises to be the most brilliant one of the kind that has ever taken place in this country. Indeed, I doubt very much whether there has ever been any exhibition in England at all approaching in importance or merit the one which is to be held within the next few months; and I cannot refrain from tendering the thanks of her Majesty's Government to those gentlemen who by their exertions in bringing about this exhibition have contributed so much to the success which we hope will follow. We appreciate the efforts of those gentlemen the more because we know that, engaged as they are in various scientific pursuits, the time which they have devoted to this matter must have caused them considerable inconvenience, and only their love of science could have induced them to render the services which they have done for the carrying out of the object. It is also gratifying to find that this exhibition has met with such a large amount of favour in all parts of the Continent, and more especially in Germany, where the Crown Princess seems to have evinced in this case her great interest in the country from which she came, and I believe it is mainly owing to her exertions and those of the Royal Family in that country that so far as Germany is concerned we are to be so ably assisted. It may not be uninteresting to the meeting that I should describe in a very few words what has been done in the present state of matters with regard to the exhibition. At meetings of the various sub-committees (appointed at the General Committee meeting in June last) during the months of February and November, reports were made of the results of visits to foreign countries by officers of the department. The sub-committees made various suggestions to the department as to objects to be procured. These have been acted upon, and many most interesting objects obtained. The committee also advised that gentlemen should be employed to visit various towns and leading manufacturers. This has been carried out with the best results by Prof. Shelley, Mr. Akroyd, Dr. Martin, Prof. Morris, Mr. Judd, and Mr. Norman Lockyer. The Foreign Secretary having through her Majesty's Ministers abroad urged the importance of co-operation on the part of foreign Governments, our appeal has been most cordially responded to. The Governments of Belgium, France, Germany, Holland, Italy, and Switzerland, have appointed committees to act in union with the general committee; and the Government of the United States has placed itself in communication with the various institutions and Government departments. Russia intends to contribute an interesting collection from the Pædagogical Museum; and the Russian Academy have formed a committee under Prof. Struve. The Austrian Minister of Instruction has taken the matter in hand for that country, and one of his officers, Mr. Fidler, is in correspondence with the Science and Art Department. I mention this to show you the intense interest that foreign countries have taken in the matter, and that to their assistance and co-operation we feel very much indebted. The appeals made to Government departments, scientific institutions, and men of science at home have been very well received. The Admiralty contributes a complete scientific outfit of a surveying ship, dredging apparatus, &c. The Post Office contributes as complete a historical collection of telegraphic apparatus as exists; much, however, unfortunately, has been broken up for want of a physical museum in which to deposit it. They also propose to communicate Greenwich time, and fire a time gun, to illustrate their method of communicating time throughout the country. The Trinity House, Ordnance Survey, Royal Observatory, and Geological Survey have also promised to contribute. From the War Office and India Office no replies have been received, but we understand they are taking steps to contribute several objects of interest, especially from the Royal Arsenal at Woolwich. The Royal Society contributes a most important collection, including some of Newton's apparatus. The Royal Institution contributes historical apparatus used by Faraday and others, and some of Dr. Tyndall's instruments. The Astronomical Society contributes Baily's apparatus for the Cavendish experiments, and Sir W. Herschel's telescope. The Geographical Society contributes maps and instruments. The Microscopical Society has promised to organise a collection of microscopes, which Mr. Sorby has especially in charge; the Horological Institute a collection of clock escapements, &c., and the Royal College of Surgeons has promised an interesting collection. King's College has promised to contribute the collection of the late Sir C. Wheatstone. At Owens College, Manchester, Professors Roscoe, Stewart, Schorlemmer, and Reynolds have promised to contribute valuable apparatus, as have also Professors Tait and Crum Brown at Edinburgh, and Sir W. Thomson at Glasgow. Trinity College, Dublin, has also promised to contribute. Contributions have been promised by the following noblemen and gentlemen, viz.:—Dr. Joule, Prof. Andrews, Mr. Gore, Lord Rosse, Mr. De la Rue, Lord Cork, Dr. Frankland, Prof. Guthrie, Mr. Norman Lockyer, Dr. Ball, Prof. O'Reilly, Prof. Barrett, and Prof. Stokes. Among instrument makers who will contribute specimens of their apparatus may be mentioned Messrs. Elliott, Apps, Browning, Adie, Grubb, Cooke, and Tisley. The following map makers will contribute:—Messrs. Stanford, Murby, and Keith Johnston. Numerous collections for teaching have been promised. Among these may be mentioned an exceedingly interesting collection prepared by Prof. Guthrie. All this apparatus is made out of simple materials by the students themselves. A committee, consisting of Dr. Stone, Dr. Pole, Mr. W. Chappell, and Mr. Baillie-Hamilton, are forming a most interesting collection illustrative of the scientific principles on which the construction of musical instruments is based. Mr. Markham is forming a collection of Arctic maps, Mr. F. Galton a collection of exploratory apparatus, Mr. Scott a collection of meteorological apparatus, and Dr. Mann a collection of instruments connected with atmospheric electricity. Various local committees have been formed to forward the objects of the Exhibition. Amongst them may be mentioned one at Leeds for Yorkshire, arising from the exertions of Prof. Thorpe. Among other interesting objects from Germany, we may look for some of Tycho Brahe's instruments, and the original air-pump of Otto von Guericke. From France we have as yet no very definite information, but we expect a very interesting collection, as the French Commission, consisting of members of the Academy of Sciences, have devoted considerable attention to the Exhibition, and the Conservatoire des Arts et Métiers have promised some of their finest things. From Italy it is hoped that some of the instruments used by Galileo, Torricelli, Volta, and Galvani may be obtained. In consequence of want of room in the South Kensington Museum, it is intended to hold the Exhibition in the western galleries of the buildings lately used for the Annual International Exhibitions, her Majesty's Commissioners having most obligingly placed them at our disposal for the purpose. I cannot overrate the advantages we have derived from the services of Mr. Norman Lockyer, who has been transferred temporarily to this department. Professors Guthrie and Goodeve have also assisted us most remarkably, and various learned societies have been invited to organise conferences and conversazioni." His Grace concluded by suggesting the desirableness of forming one or two sub-committees for the purpose of making the necessary arrangements for the reading of papers, conferences, and receptions, and expressing his confidence that a cordial welcome will be accorded to distinguished scientific visitors from other countries.

Dr. Hooker moved "that a sub-committee be formed, consisting of the presidents and one vice-president of each of the learned societies, to consider the reading of papers, conferences, and demonstrations; and, secondly, the arrangements for the receptions." Mr. Warren De la Rue seconded the motion, which was carried.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA [1]

III.

ORDER *Proboscidea*.—This name has been appropriated to a well-marked group of animals, presenting some very anomalous characters, allied in many respects to the Ungulata, but belonging neither to the

[1] Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 308.

Artiodactyle nor Perissodactyle type of that order. It has been thought that they possess some, though certainly not very close, affinities with the Rodentia, and also with the Sirenia. It is certain, however, that the two species of Elephant which are the sole living representatives of the order, stand quite alone among existing mammals, widely differing from all others in many parts of their structure, being in some respects, as in the skull, dentition and proboscis, highly specialised, though in others, as in the presence of two anterior venæ cavæ and in the structure of the limbs, retaining a low or generalised condition. A considerable series of extinct forms, extending back through the Pliocene and Miocene epochs, show the same type under still more generalised outlines. Though no true Proboscidians have as yet been found in any Eocene formations, certain recently discovered forms of that epoch from North America, if their affinities are rightly interpreted, may link them to some unknown primitive type of Perissodactyle Ungulate. The consideration of these will, however, be reserved until the next lecture.

All the true *Proboscidea* are arranged in three principal groups or genera—*Elephas*, *Mastodon*, and *Dinotherium*. Their molar teeth, by which the extinct species are chiefly known, present a remarkable series of modifications, from the comparatively simple tapiroid teeth of *Dinotherium*, with two or three strongly pronounced transverse ridges, and a normal mode of succession, to the extremely complex structure and anomalous mode of replacement found in the true Elephants. The intermediate conditions occur in the various species of Mastodon. In this genus the enamel-covered transverse ridges of each tooth are generally more numerous than in *Dinotherium*, and often complicated by notches, or by accessory columns attached to them, but in the unworn tooth they stand out freely from the crown, with deep valleys between. In the Elephants the ridges are still further increased in number, and are greatly extended in vertical height, so that, in order to give solidity to what would otherwise be a laminated or pectinated tooth, it becomes necessary to envelop and unite the whole with a large mass of cementum, which completely fills up the valleys, and gives a general smooth appearance to the organ when unworn; but as the wear consequent upon the masticating process proceeds, the alternate layers of tissue of different hardness, cement, dentine, and enamel, which are disclosed on the surface, form a fine and very efficient triturating instrument. The modification of the tooth of a Mastodon into that of an elephant is therefore precisely the same in kind as that of the molar of a Palæotherium into that of a horse, or of the corresponding tooth of an early Artiodactyle into that of an ox. The intermediate stages, moreover, even as our knowledge already extends, are so numerous that it is not possible to draw a definite line between the two types of tooth structure. As regards the mode of succession, that of the modern elephants is, as before mentioned, very peculiar. During the complete lifetime of the animal there are but six molar teeth on each side of each jaw, with occasionally a rudimentary one in front, completing the typical number of seven. The last three represent the true molars of the ordinary mammals, those in front appear to be milk molars, which are never replaced by permanent successors, but the whole series gradually moves forwards in the jaw, and the teeth become worn away, and their remnants cast out in front, while development of others proceeds behind. The individual teeth are so large and the processes of growth and destruction take place so slowly, that not more than one, or portions of two teeth, are ever in place and in use in each side of each jaw at one time. On the other hand the Dinotherium, the opposite extreme of the Proboscidian series, has the whole of the molar teeth in place and use at one time, the milk molars having been vertically displaced by pre-molars in the ordinary fashion. Among Mastodons transitional forms occur in the mode of succession as well as in structure, many species showing a partial vertical displacement of the milk molars, and the same has been observed in one extinct species of Elephant (*E. planifrons*).

Abundant remains of fossil elephants have been found in Pleistocene and Pliocene deposits in many parts of Europe, including the British Isles, in North Africa, throughout the North American continent from Alaska to Mexico, and extensively distributed in Asia. These species are chiefly known and characterised at present by the teeth, some of which resemble the existing Indian, and some the African type, but the majority are intermediate between the two, and make the distinction between *Elephas* and *Loxodon* as different genera quite impracticable. Others, again, approach so closely in breadth and coarseness of the ridges, and paucity of cementium to the Mastodons, as to have been placed by some naturalists in that genus. These form the group or sub-genus called *Stegodon* by Falconer. The best known extinct species of elephant are *E. primigenius*, the Mammoth, very closely resembling the existing Indian Elephant, of Pleistocene age, extensively distributed throughout Northern and Central Europe, North Asia, and North America, though most of the remains attributed to it in the latter country may belong to another species, *E. Americanus*, De Kay, which, according to Leidy, includes *E. Columbi*, Falc. In the frozen soil of North Siberia, complete animals, with the flesh and hair upon them, are often found, and their tusks are still collected in large quantities and in a sufficiently perfect condition to be used as ivory. *E. antiquus* and *E. meridionalis* are two other species found in Britain as well as Europe generally, of rather earlier date, and inclining more to the *Loxodon* type, as also do two species found in the island of Malta, *E. mnaidriensis* and *E. melitensis*, the latter the smallest known species of the group, sometimes not exceeding three feet in height when adult. The *Stegodon* forms, *E. clifti*, *bombifrons*, and *insignis* of Falconer and Cautley, are all from India, which would appear, from the abundance of remains, variety of form, as well as the generalised characters of some, and the geological horizon (Lower Pliocene) to be the earliest habitation of the true elephant yet discovered.

The Mastodons are distinguished from the elephants principally by the form of the molar teeth; the only absolutely distinguishing character, and that somewhat of an arbitrary one, being that the third, fourth, and fifth molars have an equal number of ridges, whereas in the elephants the third and fourth are alike, but the fifth has a larger number. In addition to the great incisor tusks of the upper jaw they often, but not invariably, have lower incisors, which are always wanting in the elephants. They are all gigantic animals, equalling or exceeding the recent elephants in size. Their remains have been found in Europe and Southern Asia in Miocene and Pliocene beds, but not of an earlier or later date. Two species, *M. arvernensis* and *M. borsoni*, occur in England in the Suffolk Red Crag. They have also been found in both South and North America. In the latter, *M. Americanus*, Cuv., *M. ohioticus*, Blumenb., with very simple ridged molars, is of Pleistocene age, its remains being found in great abundance and very perfect condition. It was, therefore, the last survivor of the genus. The Mastodons were divided by Falconer into three series called respectively *Trilophodon*, *Tetralophodon*, and *Pentalophodon*, according to the number of ridges upon the molar teeth.

The *Dinotheria* were also animals of elephantine proportions, strikingly characterised by the pair of huge tusks descending nearly vertically from the fore part of the lower jaw. The presence or absence of upper incisors has not yet been satisfactorily ascertained. The cranium was much depressed, differing from that of the elephants in the comparatively little development of the air-cells.

The remainder of the skeleton is imperfectly known, but apparently agrees in its general characters with the other Proboscideans. Its remains have been met with in abundance at Eppelsheim, near Darmstadt, and also in various other Miocene formations in the South of Germany, France, and Greece; in Asia Minor, Attock in the Punjab and Perim Island, but whether all belonging to one species (*D. giganteum*, Kaup.) or to several, the materials are not at present sufficient to determine. The genus has not hitherto been found in England or in America.

The gradual transition in the character of the molar teeth of various Proboscideans is well illustrated by the following table (compiled from Dr. Falconer's Memoirs) of the "ridge formula" of various species. The numbers are, however, only averages, and it must be remarked that the higher the numerical expression of the ridge formula in the species the more liable is the number of ridges to vary within certain limits, especially in the teeth of the lower jaw, where they are often in excess. Several species, apparently intermediate in ridge formula to those in the table, have since been discovered, as *Mastodon pentelici* and *andium*, which break down the distinction between the sections *Trilophodon* and *Tetralophodon*, and *Elephas melitensis* between *Loxodon* and *Euelephas*.

	Milk Molars.			True Molars.			Total.
	I.	II.	III.	I	II.	III.	
Dinotherium giganteum	1	2	3	3	2	2	13
Mastodon (*Trilophoaon*) *americanus*	1	2	3	3	3	4	16
Mastodon (*Tetralophodon*) *arvernensis*	2	3	4	4	4	5	22
Mastodon (*Pentalophodon*) *sivalensis*	3	4	5	5	5	6	28
Elephas (*Stegodon*) *insignis*	2	5	7	7	8	10	39
Elephas (*Loxodon*) *africanus* ...	3	6	7	7	8	10	41
Elephas (*Loxodon*) *meridionalis* ...	3	6	8	8	9	12	46
Elephas (*Euelephas*) *antiquus* ...	3	6	10	10	12	16	57
Elephas (*Euelephas*) *primigenius* ..	4	8	12	12	16	24	76
Elephas (*Euelephas*) *indicus*	4	8	12	12	16	24	76

(*To be continued.*)

THE FIRST GENERAL GEOLOGICAL MAP OF AUSTRALIA [1]

FROM its vast size and its peculiar conditions of physical geography the island-continent of Australia presents formidable difficulties alike to the topographical and the geological surveyor. Of its wide desert interior we know nothing more than what has been seen or conjectured along the tracks of the few adventurous men who have penetrated it. The eastern and southern colonies have been more or less thoroughly geologised, and expeditions have been sent to make known the capabilities of portions of the western and northern coasts. Several of the colonies have equipped geological surveys, though they have not always cared to maintain them. A great deal of miscellaneous knowledge regarding the rocks of the country has thus been acquired, but it is scattered through hundreds of blue-books, reports, memoirs, transactions of societies, newspapers, and other publications. Those who are most familiar with Australian geology, can best judge whether the time has now come when this store of diffused information may be profitably condensed in the form of a general map of the whole country. Mr. Brough Smyth has deemed that it may, and accordingly he has produced the present map—the first general geological map of Australia which, so far as we are aware, has been published.

No one could have performed so well as Mr. Smyth the difficult task of compiling this map. From his official position as Secretary for Mines in Victoria, he has, of course, unequalled facilities for doing justice to his own Colony; and from correspondence with the government departments of the other colonies, he has obtained access to all the stores of information which successive surveys and expeditions have brought into the archives of the different governments. In the winter of 1872-3 he obtained the consent of his own government to his plan for elaborating a general map of Australia, and he immediately set to work to solicit information from all quarters. In his Progress Report, dated Oct. 1, 1873, he acknowledged the assistance already received from Queensland, Western Australia, South Australia, and Tasmania, but regretted the existence of many blanks, instancing in particular the want of a geological map of the important colony of New South Wales. The present map, however, bears the conspicuous date of April 25, 1873, though confessedly incomplete in October of that year, and not published until November 1875. Mr. Smyth's name alone appears on the title. No doubt he will take care to state fully in the text which it is proposed to issue in illustration of the map, the share which others have had in the real geological surveying of which he has so carefully gathered the fruit. Still, when we think of the many years of hard bodily and mental toil which such men as W. B. Clarke, Selwyn, Daintree, and others have given to the working out of Australian geology, we cannot help expressing a feeling of disappointment that on the fore-front of this first geological map of the country no place should have been found for their names.

With the exception of this omission, which may have arisen from inadvertence, and may yet be fully atoned for, little but the most unqualified praise is to be given to this map. We have already had occasion to call attention in this journal to Mr. Brough Smyth's great energy, and to the important services which he is rendering, not only to the industrial development of Victoria, but to the progress of geology. He has probably never accomplished, however, any task more likely to be of service in Australia or more useful to geologists in other countries than this first sketch of a geological map of that great region. Though the scale of the map is only $\frac{1}{7000000}$ or 110 miles to an inch, it is no doubt quite large enough for a beginning. It shows the salient features of the geology without too many confusing details. As a specimen of cartography, the map is one of the best which has recently appeared, and it does great credit to the taste and skill of the engravers and lithographers of the Mining Department at Melbourne, where it has been produced.

The first point about this map which will probably occur to most geologists is the comparatively large area over which it has been found possible to spread geological colours. The surveys and explorations of Queensland, New South Wales, Victoria, Southern and Western Australia, have sufficed to furnish materials for colouring most of the maritime tracts, as well as a large part of the eastern half of the continent. But it might have been supposed that in spite of the journals of the few adventurers who have crossed the interior, that great inland desert would have been left an uncoloured blank upon the map. Mr. Smyth, however, has made the most of every scattered notice and stray observation. He has, coloured the exploring tracks across the country in such a way as to suggest very clearly what must be the geological structure of the interior. The eastern mountain-chain bringing up the crystalline and older palæozoic rocks from Bass Strait to Torres Strait is well shown. On the western coast an enormous mass of granite is marked as stretching over fifteen degrees of latitude, and spreading far into the interior, where it seems to pass under the vast sheets of "desert sandstone," which occupy so much of the low interior of Australia. Carboniferous rocks are coloured over large spaces in Eastern Queensland, but the compiler of this map stops the tint

[1] First sketch of a geological map of Australia, including Tasmania. By R. Brough Smyth, F.G.S., &c.

short at the northern limits of New South Wales, and makes the coal-field of that colony Mesozoic, against the earnest protest of the Rev. W. B. Clarke, whose judgment on all matters concerning the geology of New South Wales is not to be lightly opposed. Cretaceous strata, first recognised from fossil evidence by Prof. M'Coy, are represented as covering a wide belt of country from the plains south of the Darling northwards to the Gulf of Carpentaria. The tertiary deposits are massed under one tint, which spreads over most of the interior, sweeping up to the base of the inland slopes of the Eastern Alps, and down to the coast-line for many leagues on the northern, western, and southern margins of the country.

No arrows to show prevalent inclinations of strata have been inserted on the map, and as no illustrative sections are given, the reader is left to infer the relations of the formations whose general area and boundaries are so clearly defined. The required information may be expected in the promised text to accompany the map. Another omission is the want of any sign for the gold and coal-fields. This might have been easily inserted without any diminution of the clearness and beauty of the map, and would have been of value to those who take interest in the mineral resources of the country. It is to be hoped that a new edition will soon be demanded, and that these small defects in a most useful and meritorious work will be supplied.

PHYSICAL SCIENCE IN SCHOOLS

We have received the following additional letters on this subject:—

Your Rugby correspondents appear to me somewhat to misapprehend Dr. N. M. Watts's arguments on this important question. No satisfactory results, he maintains, can accrue from science teaching in schools until the subject is placed upon its true position of *educational equality*, both as regards range and time, with classics and mathematics, and no system of regulations or of examinations can be said to fulfil its object in which this position is ignored. I for my own part most cordially support Dr. Watts's views. The position at present accorded to science in English schools is, as Sir John Lubbock has clearly shown, anything but satisfactory, and this state of things seems likely to continue so long as the examinations for which the boys prepare persist in placing the science subjects in a distinctly inferior position to the older studies. Surely it is the part of examining bodies to lead and raise the education of the country. I think, however, that it has been fully proved that the "Oxford and Cambridge Schools Examination Board" has not done this, at any rate so far as science is concerned. The facts adduced by Mr. Cumming as to the small number of candidates presenting themselves for examination in science proves to my mind that the teaching of science is usually discouraged because it is usually not understood, and no efficient means of teaching science being as a rule provided, these subjects are not only neglected but their study becomes even despised by the boys. The truth is that it is the difficulty of obtaining such men as Mr. Wilson and Dr. Watts which renders the progress of science teaching in schools less rapid than some of us could wish. As soon as the supply of really competent and high class natural science masters becomes as large as that of equally distinguished teachers of classics or mathematics we may be sure that science will occupy no inferior position. Until that time arrives it behoves all those interested in the educational applications of science to take care that the teaching is really exact, methodical, and disciplinary, in short, scientific, so that if we do not progress rapidly we advance all the more surely, and we look with interest to the results of the education in those few schools such as Giggleswick and Newcastle-under-Lyne, in which science has already been placed on a footing of equality with the older studies.

Manchester, Feb. 26 HENRY E. ROSCOE

The remarks of Dr. Marshall Watts on physical science in schools in NATURE (vol. xiii., p. 311), seem to me to call for one or two observations in addition to those made by Mr. Wilson and Mr. Cumming in your columns last week (p. 329).

Dr. Watts selects a few questions from the examination papers that were set in heat, chemistry, and geology, by the Oxford and Cambridge Schools Examination Board in 1854, the first year of its existence, in order to show what he considers the very elementary nature of the knowledge required, and he adds that "with the exception of the last question [naming certain rocks and fossils] there is no test of a practical kind at all."

Now it is only fair to state that although it is quite true that there was no examination in practical chemistry in 1854, yet in the regulations for the next year "the elements of practical qualitative analysis" were added to "the elementary parts of inorganic chemistry," and last July those candidates who took in chemistry were examined for three hours in practical laboratory work, six substances being given to each boy for analysis.

Moreover, with regard to theoretical chemistry, the paper that was set last year was decidedly harder than that of the year before. I inclose a copy, and should be glad if you could find space to print it. As a matter of fact it is harder than the average chemistry papers of the London University Matriculation Examination, and quite as hard as an ordinary Oxford Pass Paper.

"*Natural Philosophy* (*Chemical Division.*) (*Time* 1½ *hours.*)

A.

"1. What happens when pure iron is dissolved in excess of dilute sulphuric acid? Give an account of the properties of the solution which is obtained, and the tests by which you would show what salt of iron is present. Suppose some of the solution were boiled with potassium nitrate, what changes would you expect to take place?

"2. Explain atom, molecule, acid, base. How can you show the composition by weight and volume of hydrogen with chlorine, bromine, and iodine? mention the best methods of obtaining these compounds in the state both of gas and in solution.

"3. How is analysis of air made with the eudiometer? Describe how to correct the observations for pressure, temperature, and aqueous vapour. Suppose 100 c.c. of oxygen to be mixed with 10 c.c. of marsh gas and exploded, find the amount of the residual gases.

"4. What is the percentage composition of nitrous and nitric oxides? How are these bodies prepared? Distinguish between the properties of nitrates and nitrites.

"5. Describe briefly the manufacture either of sulphuric acid or of bleaching powder.

"6. Account for the production of carbon mon-oxide in the blast furnace, and show what action it has in reducing the roasted iron-stone. What is the best method of preparing carbon mon-oxide: in what respects does it differ from the di-oxide?

"7. How is the metal aluminium prepared? Describe the manufacture of alum, and give a brief account of the properties of alumina.

"8. Describe the preparation and properties of the bodies $SnCl_4$, HgC_2N_2, PbO_2, $K_2Cr_2O_7$, HCN.

"*Practical Chemistry.* (*Time* 3 *hours.*)

"1. The substances marked 1, 2, 3, 4 are simple salts.

"2. The substances marked 5, 6 are elements.

"You are requested to find out what they are, and to write a full account of the methods you use."

Now at the risk of being accused of taking a low standard, I cannot help thinking that although some of these questions may be called "very easy," yet there are others quite sufficiently difficult for the ordinary public school-boy, who has a great many other things to work at besides natural science.

A boy must have read his chemistry thoughtfully, to say the least, who could answer the whole of Question 1 thoroughly. In Question 2 there is ample opportunity for showing a deeper knowledge than could be obtained by skimming over some "outlines of chemistry." So again the explanation and illustration of the peculiar oxidising and reducing properties of *nitrites*, in Question 4, and the description of the preparation and properties of the different bodies enumerated in Question 8, could, I maintain, only be given satisfactorily by boys who had acquired something more than a mere "modicum" of chemical knowledge.

It must also be borne in mind that in order to pass the Chemical Division of Group IV., a boy must take in, in addition to the chemistry of the metallic and non-metallic elements and practical analysis, either heat or magnetism and electricity.

Now although there may be reasons for combining together heat and chemistry, so long as it is understood that only the more elementary parts of heat will be required, yet it is certainly unreasonable to add on as an extra such a very comprehensive subject as that of magnetism and electricity, frictional and voltaic, including electro-magnetism.

Surely, to say the least, electrical science is quite as worthy of an independent existence as botany or geology, and I much doubt whether many would hesitate in admitting it to be much harder than either.

My own opinion is in favour of Mr. Wilson's suggestion—to divide Group IV. into Pass subjects and Honour subjects, requiring only an elementary knowledge of theoretical chemistry, and perhaps the simpler parts of heat for the one, while practical analysis with higher knowledge of heat, *or* electricity and magnetism, might be required from those who aimed at taking honours in science.

It is perhaps due to the school to say that we can hardly be supposed to be frightened at the prospect of these examinations. Last July three in the Sixth took in chemistry as a certificate subject: all passed and two obtained "distinction"—three being the total number who obtained such distinction out of the twenty-eight candidates who presented themselves for examination in this subject.

T. N. HUTCHINSON

Rugby

In my letter last week, p. 329, I said that the papers set in science in the certificate examination *last year* were very easy. This was a slip. I was absent from England when they were set, and had never seen them. I had in my mind the papers of the year before.

The papers of last year were quite hard enough. It must be remembered that very many schools give only *two lessons a week* to science.

JAMES M. WILSON

ANNIVERSARY ADDRESS OF THE PRESIDENT OF THE ROYAL GEOLOGICAL SOCIETY, JOHN EVANS, F.R.S.

MR. EVANS began by referring to the immense advances in geological science since 1825, when the Society received its charter, and pointed out that although there now existed a considerable body of professional or trained geologists, yet amateurs need not be discouraged from taking up the science which now embraces so wide a field that there is ample room for both. He then referred to the prosperity of the Society, to its publication, its medals, and other means for fostering the science, and to its valuable museum, an "interesting notice of which," he intimated, "appeared in NATURE, vol. xiii. p. 227." Mr. Evans then spoke of the present prospects of the science, of the bearing which recent discoveries in other branches of knowledge has upon it, and of the direction in which future discoveries are likely to be made. In this connection he referred to the recent researches in solar physics by means of spectrum analysis and solar photography, as having a close and intimate bearing on the early history of the earth, and which was discussed by Prof. Prestwich in his inaugural lecture at Oxford (NATURE, vol. xi. p. 290). He spoke also of the importance of spectrum analysis to the metallurgist, referring to the researches of Mr. W. C. Roberts in quantitative analyses of gold-copper alloys. Mr. Evans then spoke at some length of the important results already attained by the *Challenger* Expedition as to the nature of the sea-bottom. In speaking of the Arctic Expedition, from which geology hopes to gain much, he referred to the powerful evidence which exists in the fossil flora of Greenland and Spitzbergen, of the prevalence in the Arctic regions at one period of a distinctly warm climate.

Mr. Evans then went on to say:—The three points which it appears to me are most important to bear in mind with regard to the Arctic flora are:—1, That for vegetation such as has been described, there must, according to all analogy, have been a greater aggregate amount of summer heat supplied than is now due to such high latitudes; 2, that there must have been a far less degree of winter cold than is in any way compatible with the position on the globe; and 3, that in all probability the amount and distribution of light which at present prevail within the Arctic circle are not such as would suffice for the life of the trees.

Should the present Arctic expedition succeed in finding traces of what must be regarded as a temperate, if not indeed a sub-tropical fossil flora, like that of Greenland, and Spitzbergen, extending to latitudes still nearer the pole, it does appear to me that geologists will be compelled to accept as a fact that the position of the axis of rotation of our planet has not been permanent; and they will have to call upon astronomers to find some means of admitting what they now regard as impossible.

An astronomer and mathematician of no mean ability, the late Sir John W. Lubbock, in a paper communicated to this Society in 1848, has speculated upon this subject, which was in consequence discussed by the late Sir Henry Delabeche in his Presidential Address in 1849.

Sir John Lubbock remarked that the dictum of Laplace as to the impossibility of accounting for the changes which have taken place on the surface of the earth, and in the relative positions of land and water, by a change in the position of the axis of rotation, was founded upon the absence of two considerations, both of which appeared to him essential. These were—

1. The dislocation of strata by cooling,
2. The friction of the surface.

The latter consideration is apparently of but little importance; but with regard to the former, he pointed out how, if from any cause the axis of rotation did not coincide with the axis of figure, the pole of the axis of rotation would describe a spiral round the pole of the axis of figure until it finally became, as it is at present, identical with it. He considered it unlikely that originally the axis of rotation should have coincided exactly with the axis of figure, unless the whole globe were perfectly fluid; but added that we might go back to a time less remote, when the earth was in a semifluid state, and in consequence of the different degrees of fusibility of different substances, was partly solid, in irregular masses, and the two axes did not, in consequence, coincide. We might, he added, assume the original state of want of uniformity between them to have been at a period even more recent, when the earth consisted of land and water, and was suited for the support of animal life. He then proceeds to show how, if, after any length of time the solid spheroidal part of the earth moved about any new axis of rotation, the water would occupy a new position about a new equator, land would become sea, and sea land, &c.

He adds that if the axis of the earth would suffer a displacement by reason of the causes which produce the precession of the equinoxes, we should have another and more natural way of accounting for the existing phenomena; but this has been held to be impossible.

I am not at present going to question whether this holding is correct; but with regard to Sir J. W. Lubbock's reasoning as to the necessity of the axis of figure coinciding with that of rotation, it appears to me of the greatest importance; for if it hold good, any alteration in figure cannot but have some effect on the position of the axis of rotation. No doubt, if the whole globe, or even the solid portion of it, were a regular spheroid, with a large equatorial protuberance, any modification on its surface would have to be on an enormous scale to produce any sensible effect upon its axis of revolution. But, after all, is the earth, strictly speaking, a spheroid?—and are not some of the arguments and dicta based upon its spheroidal character founded on a fallacy? For it does appear to me a fallacy to treat as one homogeneous spheroid, a body partly consisting of a mass of solid or quasi-solid matter of irregular form, and partly of a liquid mass in constant motion, irregularly distributed over a portion of its surface. No doubt the contour of the liquid portion is, according to established geometrical laws, almost that of a regular spheroid; but its distribution, except in the case of inland seas, can have but little to do with the regulation of the movement of the solid body on which it rests. It is true that Laplace has maintained that "whatever may be the law of the depth of the ocean, and whatever the figure of the spheroid which it covers, the phenomena of precession and nutation will be the same as if the ocean formed a solid mass with this spheroid;" but do the position of the axis of revolution and its permanence in one spot come under the same category as precession and nutation? It certainly appears to me that the position of the axis of revolution must mainly depend upon the form of the mineral portion of the globe, and be but in the slightest degree affected by the distribution of the ocean, the specific gravity of which is moreover only about one-fifth of that of the more solid portion.

With regard to the permanence of the axis of rotation, if it must of necessity coincide with the axis of figure, and if the figure of the mineral portion of the earth, in consequence of upheavals and depressions, of the wearing away of continents and the transportation of their constituents by mechanical or even chemical means, is being constantly changed, so as to acquire a new axis, then the axis of rotation must also as constantly be undergoing a change of position.

Let us now glance at some of the irregularities of form of the more solid part of the globe as at present existing. The difference between the polar and equatorial diameters of our globe has been calculated at about 26 miles, or about 13 miles in the radius; but at the equator itself, little more than one-fifth of the circumference of the globe is dry land, and nearly four-fifths are sea; and this sea is by no means shallow, as the soundings taken by the "Tuscarora," the "Challenger," and other exploring vessels will prove. Leaving those taken near land out of the calculation, I find that 48 soundings in the Pacific, between 15° and 30° north latitude, give an average depth of 2,634 fathoms, or 5,268 yards, that is to say, within a few yards of three miles. The South Pacific does not appear to have been so well explored; but across the Atlantic, in the equatorial regions between 10° N. and 10° S., I find that an average of 32 soundings gives a mean depth of 2,309 fathoms, or 4,618 yards, while, in one spot in lat. 15° S., Sir James Ross did not find the bottom with a line of 4,600 fathoms, or nearly 5¼ miles. In the Indian Ocean, within the same limits, 20 soundings give an average of 2,468 fathoms, or 4,936 yards, or more than 2¾ miles. Taking these soundings as fair representations of the depth of the sea in the neighbourhood of the equator, it appears that we may at once reduce the equatorial diameter of the more solid part of the globe by from 5½ to 6 miles over nearly four-fifths of its circumference; that is to say, we may reduce the usually accepted equatorial protuberance from about 13 miles to a little over 10. It is not within my province to inquire whether the fact of so large a portion of the equatorial protuberance being of so much less specific gravity than if it were composed of mineral matter, will in any way affect the established calculations with regard to the precession of the equinoxes and the nutation of the poles, or, what is of more importance to us, the inferences with regard to the crust of the earth which have been thence deduced.

But while so large a portion of the surface of the land is, in the equatorial regions, so much below the normal level, there are, especially in the northern hemisphere, large tracts of land which, like the great plateau of Tibet, are some thousands of feet above it. The average elevation of the whole of Asia has, indeed, been estimated at 377 yards, or nearly a quarter of a mile above the sea-level. The depth of the ocean in non-equatorial regions must no doubt be taken into account; but practically, the spheroidicity of the globe, on which the stability of the pole has been held to depend, may be regarded as, even at the present time, considerably less than is usually supposed. When, however, we come to think of the enormous elevations and depressions which some parts of the globe have undergone during geological time, it is by no means difficult to imagine conditions under which the general average, so to speak, of the surface, would approach much more nearly to the form of a sphere, and the globe would become much more sensitive of any disturbances of its equilibrium; but whether the globe is a sphere or a spheroid, it is hard to see why disturbances of its equilibrium should not affect the position of its axis of rotation.

Taking our globe with the distribution of land and water as at present existing, I should like to inquire of mathematicians what would be the theoretical result of such a slight modification, geologically speaking, as the following:—Assume an elevation to the extent, on an average, of 4,000 feet over the northern part of Africa, the centre of the elevation being, say, in 20° north latitude. Assume that this elevation forms only a portion of a belt around the whole globe, inclined to the equator at an angle of 20°, and having its most northerly point in the longitude of Greenwich, and cutting the equator at 90° of east and west longitude. Assume that along this belt the sea-bottom and what little land besides Africa it would traverse were raised 4,000 feet above its present level over a tract 20° in width. Assume further that the elevation of this belt was accompanied by corresponding depressions on either side of it, so as to leave the total volume of the mineral portion of the earth unaffected. Would not such a modification of form bring the axis of figure about 15° or 20° south of the present, and on the meridian of Greenwich, that is to say, midway between Greenland and Spitzbergen? and would not, eventually, the axis of rotation correspond in position with the axis of the figure?

If the answer to these questions is in the affirmative, then I think it must be conceded that even minor elevations within the tropics would produce effects corresponding to their magnitude; and also that it is unsafe to assume that the geographical position of the poles has been persistent throughout all geological time.

It is not the first time that I have insisted upon this point; for, some ten years ago, I pointed out another possible means of accounting for a change in the geographical position of the axis of the earth. My hypothesis was, however, founded on the assumption of the globe consisting of a comparatively thin crust, with an internal fluid nucleus over which the crust would slide when, from any geological cause, its equilibrium was disturbed. To this it has been objected [1]—1st, That there would be a tendency in the transfer of sediment from one part of the globe to another, and in the various elevations and depressions of land simultaneously, to balance each other; and 2nd, that the friction over the nucleus would be too great, and that, owing to the earth being a spheroid and not a perfect sphere, any motion of the crust would be attended by great resistance, and the bending and rending of its mass.

To these objections it may be replied that the effects of the transfer of sediment from one place to another, and of elevations and depressions of land going on at the same time, are just as likely to be doubled by the depressions taking place in the same hemisphere as the elevations, but on opposite sides of the pole, as they are to neutralise each other; and, 2ndly, that with a comparatively thin crust, the readjustment to a fresh position on a nucleus so slightly spheroidal as that supposed to exist in the earth, is not accompanied by any great change of form, or certainly not more than what the contorted rocks all over the world have undergone.

I am not, however, on the present occasion, going to attempt to prove that the assumption involved in my hypothesis is reasonable. How we are to account for all the vast oscillations of the earth's surface, which we find to have been going on ever since the earliest geological period up to the present day, on any assumption more reasonable, I will leave for others to determine. I have already called attention to the bearing which recent researches in solar physics have upon this subject, and I am content to leave the matter as it stands, in the hope that before many years have passed, we may learn more either in its proof or disproof.

The moral which I wish to draw from all that I have just said is this:—That so long as there is a possibility, not to say a probability, of the geographical position of the poles having changed, it is premature to invoke intense glacial periods to account for all the glacial phenomena which may be observed. Much as we must esteem the labours of M. Adhémar and Mr. Croll, and others who have gone so deeply into the question of glaciation—enormous as have been the effects of ice in this and other countries—there are many who cannot but feel that the ice-caps invoked almost transcend our powers of belief, and who will be grateful to any astronomer or mathematician who will bring the pole

[1] Lyell's "Principles," 11th edition, vol. ii. p. 209.

round which they were generated, somewhat nearer to our doors.

There is yet one point on which, before quitting the subject, I may add a few words. Sir J. W. Lubbock, in the paper from which I have already quoted so much, has hinted at the possibility of some want of homogeneity in the constitution of the globe, so that in cooling, the position of the axis of rotation may have changed. The varying amount of subterranean heat and volcanic energy in the same region at different periods of the earth's existence has frequently been commented on, as has also the varying degree of subsidence or elevation in the same tract at different times. The forces, whatever they may be, to which these upward and downward movements are due, have, as Sir Charles Lyell has remarked, "shifted their points of chief development from one region to another, like the volcano and the earthquake, and are all, in fact, the results of the same internal operations to which heat, electricity, magnetism, and chemical affinity give rise."

Whether changes in the specific gravity of enormous masses of rock in consequence of their being heated would be of sufficient degree to disturb the equilibrium of the globe, is a difficult question; but the remarkable position of the magnetic poles of verticity with regard to the actual poles of the earth, and the distribution of the magnetic force over the earth's surface may, as has been suggested to me by Capt. F. J. Evans, F.R.S., have some geological significance. These poles are in lat. 70° N., long. 96⅔° W., and in lat. 73½° S., long. 147½° E. If we draw a circle around the globe, cutting these two points, we find that the magnetic poles, instead of being 180° apart, are only about 165° distant in one direction, while they are about 195° in the other. In like manner the magnetic equator, or line of no dip, differs considerably in position from the terrestrial equator, being drawn about 15° to the south over South America, and about 10° to the north over Africa, and in passing the great Asiatic continent. There is also this singular circumstance, which was insisted upon by Sir Edward Sabine nearly forty years ago—viz., that if the globe be divided into an eastern and a western hemisphere by a plane coinciding with the meridian of 100° and 280°, the western hemisphere, or that comprising the Americas and the Pacific Ocean, has a much higher magnetic intensity distributed generally over its surface, than the eastern hemisphere, containing Europe and Africa and the adjacent part of the Atlantic Ocean. The points of the greatest intensity of the magnetic force, moreover, do not correspond with the magnetic poles, as there are two such foci in the northern hemisphere (those of America and Siberia) making it probable that there are two also in the southern hemisphere.

Such facts would seem more in accordance with a want of uniformity in the inner constitution of the globe than with its being a body all the parts of which are arranged in perfect symmetry. Some abnormal features in the direction of gravity in different parts of the world seem also to afford corroborative evidence to the same effect. The subject is one of perhaps too theoretical a character for the geologist to approach; but if any definite connection could be established between terrestrial magnetism and the internal constitution of the globe, we might, possibly, be justified in drawing the inference from its phenomena, that there are forces in operation in the interior of the earth by which its equilibrium may have been disturbed, and its axis of revolution thus caused to change in position.

(*To be continued.*)

NOTES

THE Italian naturalist Beccari is again in New Guinea, exploring the north coast near Humboldt's Bay, along with an expedition sent out by the Governor-General of the Dutch Colonies. Of his former companion, D'Albertis, now at Yule Island, near the south-eastern extremity of New Guinea, we regret to hear that one of his collections from that district, containing about 35,000 insects and 700 reptiles, has been lost on its transit from Cape York. The bird-skins were, fortunately, not sent by the same vessel, and are therefore safe.

THE Paris Observatory has received for January last Meteorlological observations made six times each day, at the Norma Schools, at the following thirty-four places:—Albertville, Alençon, Amiens, Aurillac, Avignon, Beauvais, Besançon, Bourg, Bourges, Caen, Carcassonne, Chalons, Chartres, Chaumont, Clermont, Commercy, Dragnignan, Foix, Grenoble, Le Mans, Le Puy, Loches, Lons-le-Saulnier, Mâcon, Melun, Mirecourt, Nimes, Orléans, Parthenay, Périgneux, Privas, Rouen, Troyes, and Villefranche. The importance of this valuable system of observation in its bearings on the peculiarly difficult problem of the meteorology of France, it would be difficult to over-estimate, especially when taken in connection with the numerous observers of thunder-storms and other phenomena requiring few or no instruments for their observation, whose services are being secured in different departments.

PROF. CANTONI has intimated to the Permanent Committee appointed by the Meteorological Congress of Vienna that the Italian Government has been pleased to intimate its readiness to invite the countries which were represented at Vienna to attend a Meteorological Congress in Italy in the autumn of 1877.

THE Permanent Committee of the Vienna Meteorological Congress have announced their intention to hold their next meeting in London, in Easter week, commencing April 18 next.

NINE Lectures on the Shoulder-Girdle and Fore Limb of Vertebrata, will be delivered in the Theatre of the Royal College of Surgeons, on Mondays, Wednesdays, and Fridays, at 4 P.M., commencing on Monday, March 6, 1876, by Professor W. K. Parker, F.R.S.—Lecture I. March 6. The Vertebrate Skeleton. II. March 8. Shoulder-girdle and Fore Limb of Fishes. III. March 10. Shoulder-girdle and Fore Limb of Fishes. IV. March 13. Shoulder-girdle, Fore Limb, and Sternum of Amphibia. V. March 15. Shoulder-girdle, Fore Limb, and Sternum of Reptiles. VI. March 17. Shoulder-girdle, Fore Limb, and Sternum of Birds. VII. March 20. Shoulder-girdle, Fore Limb, and Sternum of Mammals. VIII. March 22. Shoulder-girdle, Fore Limb, and Sternum of Mammals. IX. March 24. Summary and conclusion.

THE following is the business to be brought before the Half-Yearly General Meeting of the Scottish Meteorological Society to-day:—1, Report from the Council of the Society; 2, Report from the Ozone Committee; 3, The Salmon, Grilse, and Trout Fishings of the Tweed, in relation to Meteorology, by G. L. Paulin, Esq., and the Secretary; 4, Report from the Herring Committee.

THE following memoirs and reports of the United States Geological and Geographical Survey of the Territories, under the direction of Prof. Hayden, are now in the press, and will be issued during 1876:—1. Monograph of the Rodentia of North America, by Elliott Coues and J. A. Allen. Quarto, about 500 pages, with numerous illustrations. 2. Monograph of the Geometrid Moths, by Dr. A. S. Packard, jun. 350 pages quarto, with 13 plates. 3. The Fossil Invertebrata of the Western Territories, by J. B. Meek. 600 pages quarto, and 45 plates, with numerous woodcuts in text. 4. The Fossil Flora of the Lignitic group of the Western Territories, by Leo Lesquereux. 65 plates, quarto. 5. The Ethnography and Philology of the Hidatsa Indians (Minnetarees of the Upper Missouri). 400 pages, octavo. 6. Annual Reports of the Survey for 1874 and 1875. 7. Bulletin of the Survey for the year 1876; several important articles in press. Other works are in process of preparation, and may be printed before the close of the year.

THE *Bulletin* of the United States Geological and Geographical Survey of the Territories, Prof. Hayden in charge, has just issued Nos. 5 and 6, which close the year 1875. In No. 5, there are nine articles on various subjects of Geology and Natural History. In No. 6 there are four articles, with table of contents and complete index. It is suggested by Prof. Hayden that the two *Bulletins* of 1874 be bound with those of 1875, as Volume I. The index and title-page have been made with this idea in view. Volume I. will then comprise about 600 closely printed 8vo. pages, with 26 plates, sections, &c.

THE Cincinnati Observatory, since its reorganisation, under the charge of Mr. Ormond Stone, has again assumed a satisfactory position among kindred institutions in the United States. A School of Astronomy has been established, with quite a number of pupils. The double-star observations made by Prof. Mitchell have been reduced, and are ready for the printer. They embrace between 300 and 400 observations, made during the years 1846, 1847, and 1848. A series of double-star measurements has also been entered upon, restricted to those south of the equator, with a result of bringing to light quite a number of new close double stars.

THE first annual report of the Chicago Botanical Garden has been published. A plan has been prepared for the permanent arrangement of the entire ground. At the date of the report living specimens of ninety-five species of native plants had been placed in the garden, and seeds of 456 species collected in sufficient quantity for exchange.

WE understand that Dr. J. Gray McKendrick intends offering himself as a candidate for the chair of Physiology in Glasgow University, when Prof. A. Buchanan's intimated intention of resigning that chair has been carried into effect.

M. PAUL BERT has offered a prize for the best means of protecting the lives of aëronauts and mountain-climbers in circumstances where cold and rarefaction of the air become dangerous. The prize offered by M. Bert is a 20*l*. gold medal, and the competition is open up to December 31, 1876.

THE papers read on Monday evening at the Royal Geographical Society were, "On the Shueli Valley of Burmah," by Mr. Ney Elias; and "Afghan Geography," by Mr. C. R. Markham. The paper of Mr. Ney Elias described an alternative route into China to that which Mr. Margary had unfortunately taken, and been murdered. In introducing the second paper, on "Afghan Geography," Mr. Markham stated that its materials had been collected from the journals of the late General Lynch, compiled in Afghanistan. The paper gave full details of the history, geography, and antiquities of Afghanistan. General Lynch described the country through which he passed as being full of lovely valleys, inhabited by a gentle and hospitable people, as studded with mines of gold and silver and coal, as teeming with fertility, and as being rich in ancient monuments, in inscriptions, and in sculpture. A map of Afghanistan is being prepared in the War Office, embracing all the existing materials, and that map when published will show how many gaps in our geographical knowledge of Afghanistan still remain to be filled up.

THE *Bulletin* of the French Geographical Society contains a paper by M. V. A. Malte-Brun, giving an appreciative and sympathetic account of the organisation of the English Arctic Expedition and its progress up to the latest news received. M. Malte-Brun hopes to see the day when a French Expedition will set out for the North Pole. Abbé David's Second Voyage of Exploration in Western China, 1868–1870, is described, and M. J. Codine gives an account of the discovery of the African Coast from Cape St. Catherine to the Great Fish River by the Portuguese during the years 1484-1488.

ACCORDING to the *Annuaire* for 1876, there appear to be five English Academicians and twenty-nine English correspondents of the Institute of France. As Academicians in Science are Prof. Owen and Sir G. B. Airy; as Correspondents in the Class of Science are Professors Sylvester and Adams (Cambridge), Sir T. MacLear, Rear-Admiral Richards, General Sabine, Dr. J. P. Joule (Manchester), Dr. E. Frankland, Prof. A. W. Williamson, Prof. W. H. Miller (Cambridge), Dr. Hooker (Kew), Dr. W. B. Carpenter, Dr. Huggins, and Mr. Lockyer.

THE *Morgenblad* of Christiania states that a singular phenomenon was observed there after a recent violent storm. A number of worms were found crawling on the snow, and it was imposssible to find the places from which they had issued, everything being frozen in the vicinity. Similar circumstances were reported from several places of Norway.

M. CYBOULSKY, a mining proprietor in Siberia, is said to have given a sum of 100,000 roubles to help the Government to found the Tomsk University.

THE number of students registered in the Paris Faculty of Medicine this year is 6,500, the largest number yet reached. On February 22, the Municipal Council of Paris voted a sum of six millions of francs for the construction of new buildings round the old ones belonging to the Faculty. The property of the buildings now in existence has been given up by the State to the City of Paris on the express condition that they should always be devoted to the Faculty of Medicine.

MANY of our readers, we are sure, will rejoice to hear that a movement is on foot in Germany to abolish the crabbed printed German alphabet and adopt Roman type. We sincerely wish the movement may lead to the desired result, and that it will extend to the still more vexatious written alphabet.

A NEW scientific periodical entitled *Electricité* has been issued in Paris, under the patronage of Count Halley d'Arroz, director of the International Electrical Exhibition of 1877. It will be profusely illustrated, and will be used by the Commission of Organisation as one of its official organs.

THE Committee appointed by the Préfet de la Seine to superintend the construction of lightning conductors in Paris has been changed into a permanent one. A sum of 8,000*l*. has been appropriated by the Municipal Council for reconstructing all the lightning conductors in Paris, or at least all those which may be found defective or inefficient. This sum is a first instalment, as the whole of the work, it is supposed, will cost 50,000*l*., although the Committee has not recommended the use of copper conductors. It is deeply to be regretted that the teachings of Sir Snow Harris are not better understood in France, as the Committee has adopted a number of excellent recommendations. Until the appointment of the Committee lightning conductors were constructed by ordinary blacksmiths, under the superintendence of architects who knew nothing of physics. A competitive adjudication took place on Feb. 19 between a number of competent electricians for the construction of all the lightning conductors on the Paris municipal monuments. The successful competitor is M. Grenet, the well-known electrician. A *cahier des charges* with seventy carefully-drawn provisions has been published. The electric continuity of conductors must be tested yearly, and the contractor will be paid by instalments, so that his claim will be cleared up only when the efficiency of his work shall have been tested during a certain number of years. The platinum cone has been abolished and replaced by a copper cone. The quality of the iron, as well as of the copper and solder, is to be tested by chemical analysis. The insulation of rods has been abolished as being useless. The Commission has diminished the diameter of protection area, which was supposed to be twice the height, and has reduced it to 1·45. The consequence is that rods are to be multiplied. The principal provisions of the 1876 *cahier des charges* have been drawn in accordance with the instructions published by the French Academy of Sciences in 1825.

WE have received a copy of the rules adopted at a recent meeting of the newly-formed Mineralogical Society of Great Britain and Ireland. The object of the Society is the study of mineralogy and petrology, and it will be composed of ordinary members, associates, and corresponding members. Besides general and annual meetings, local meetings may be held at any time and place as may be agreed upon by six members or associates. The Society will publish a journal. The President is

Mr. H. C. Sorby, F.R.S., the Secretary, Mr. R. P. Grey, F.G.S., and the Council is composed of men whose names are well-known in science.

THE head of the publishing firm of Didot, died a few days ago at the age of eighty-six. The deceased was a member of the Academy of Inscriptions, and under his direction the firm published a number of valuable scientific books. The Didot firm hold the office of printers to the French Institute, M. Gauthier Villars being only printer to the Academy of Science.

THE second annual meeting of the members of the Scientific Club was held at the Club House, Savile Row, on Thursday, the 17th Feb. Major F. Duncan, D.C.L., Chairman of the Committee, presided. The Report of the Committee, showing the rapid progress the Club had made during the past year, was unanimously adopted.

WE are asked to state that supplemental meetings for the reading and discussion of papers by students of the Institution of Civil Engineers have been appointed for the following Friday evenings:—February 25, March 3, 10, 17, 24, and 31. The chair will be taken at 7 o'clock on each evening, and successively by Dr. Pole, F.R.S., Sir W. G. Armstrong, C.B., F.R.S., Mr. H. Hayter, Mr. Woods, Mr. Brunlees, and Mr. Berkley, Members of Council.

AMONG the papers in the published "Proceedings" of the Belfast Natural History and Philosophical Society for 1874-75 are the following:—Presidential Address on atoms and automata, by Joseph J. Murphy, F.G.S.; On some Irish Palæozoic fossils, by Rev. John Grainger, D.D.; On the water-bearing strata between Moira and Lurgan, by Robert Young, C.E.; On the geographical distribution of mammals, by R. O. Cunningham, M.D., Professor of Natural History, Queen's College, Belfast; A suggestion on chemical notation, by the president, Joseph John Murphy, F.G.S.; Further notes on some of the swimming birds frequenting Belfast Lough, with special reference to the Great Northern Diver, by R. Lloyd Patterson.

THE additions to the Zoological Society's Gardens during the past week include a Virginian Eagle Owl (*Bubo virginianus*) from N. America, presented by Mr. H. Knight; two Widgeons (*Mareca penelope*), a Common Wild Duck (*Anas boschas*), a Lesser Black-backed Gull (*Larus fuscus*), three Herring Gulls (*Larus argentatus*), two Common Gulls (*Larus canus*), three Black-headed Gulls (*Larus ridibundus*), European, presented by Mr. C. Clifton; a Common Otter (*Lutra vulgaris*), European, received in exchange; a Darwin's Pucras (*Pucrasia darwini*) from China, a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; a Zebu (*Bos indicus*) born in the Gardens.

SCIENTIFIC SERIALS

THE *American Naturalist* has changed its form this year. In future it is to be published by Messrs. H. O. Houghton and Co., Cambridge, Mass., under the editorship of Dr. A. S. Packard, jun. The amount of matter is increased, and the articles will be of a more popular nature than previously. A department of Geography and Travel is added, and Dr. R. H. Ward, of Troy, N.Y., will superintend the Microscopy. There seems to be considerable difficulty in the production of a science journal in America, and we think that there is still room for improvement. The first paper in the January number is on "Burs in the Borage family," by Prof. Asa Gray, in which a new form, named *Harpagonella*, is described, having been obtained by Dr. E. Palmer, from Guadalupe Island, off Lower California.—The Rev. S. Lockwood describes the habits of the "Florida Chameleon" (*Anolis principalis*).—Mr. David Scott writes on the proper specific name of the Song Sparrow, *Melospiza fasciata* (Gondin), not *M. melodia* (Wilson).—Mr. J. C. Russell shows of what great value the New Zealand Flax (*Phormium tenax*) would be if a method of cleaning it could be discovered.—Mr. J. A. Allen discusses the availability of certain Bartramian names in ornithology, and opposing Dr. Coues' desire to establish some of them. A list is given of those of Bartram's names which Dr. Coues wishes to re-establish.—Prof. N. S. Shaler describes the first session of the Harvard Summer School of Geology.—Ancient ruins in S.W. Colorado are illustrated and described from photographs taken by Mr. W. H. Jackson, the photographer to Prof. Hayden's United States Geological Survey of the Territories, including a house, a round tower, and a square one of Indian construction.—Reviews of Sach's "Botany" (English translation) and Caton's "Summer in Norway," with badly-engraved drawings, are given, together with notes, &c., which conclude the number.

Poggendorff's Annalen der Physik und Chemie, No. 11, 1875.—The tuning-fork has become an important instrument in physical observations, and this number of the *Annalen* begins with a description of experiments by Dr. Ettingshausen, with a stroboscopic tuning-fork apparatus, in which the motion of an electromagnetically excited fork is observed through slits arranged in connection with another fork of nearly the same pitch placed near it. The following are some of his results:—Compared with pendulum motion, that of tuning-forks is somewhat retarded in the inward course, and accelerated in the outward. The vibration time considerably increases with increase of the time of closure of the circuit. The electro-magnetically excited fork vibrates (where the divergences are not too great) more quickly than if the vibrations were caused by elasticity alone. With equal amplitude the duration of vibrations increases slightly with the time the apparatus has been in action; and it decreases with increasing density of the surrounding air.—Electric phenomena occupy a large share of attention in this number, especially various actions of the spark. M. Peters, extending the researches begun by M. Antolik on "gliding" electric sparks, describes effects obtained by letting the spark glide on smoked paper brought near the machine on a glass table. The trace of the flash showed three different parts, each about a third of the whole length. In the *positive third* were numerous branchings outwards from a middle part, which consisted of a succession of parallel dark and bright strips (the darkest in the middle); the *negative third* showed no branchings, and the parallel strips were in reverse order; the *middle third* was distinguished by a greater width and brightness. M. Peters seeks to account for these phenomena. In another note he points out some differences between spark-forms from large inductors and those from the Holtz machine.—A paper by MM. Mach and Wosyka, also suggested by Antolik's experiments, furnishes reason for thinking that the soot figures produced are due to air motions, and especially sound motions.—Again, M. Riess gives an account of the phenomenon of weak electric sparks (as he called them), which differ from the ordinary strong sparks in form, light, sound, and other properties. A mode of producing them was formerly described. He observes that the greater length of the negative electrode has no essential connection with their production, and that, in regard not only to length, but to light and sound, they are independent of the composition of the circuit in which they occur.—Some striking new light phenomena of electricity are also described by M. Holtz.—In a note on the dielectric constants of liquids, M. Silow furnishes experimental proof of a proposition of Helmholtz with regard to attraction of two electric masses situated in an insulating medium, and a valuable paper by M. Herwig treats of the magnetisability of cylindrical iron pipes in different directions; he considers that in addition to the forces hitherto taken into account, there are further molecular magnetic forces which are of the greatest importance. These act within a magnetic line in the direction of the entire magnetisation, and in interrupted portions of a magnetic line in the contrary direction.—MM. Hildebrand and Norton endeavour to fill up some gaps in our knowledge of the properties of metallic cerium, lanthanum, and didymium; having obtained these elements by the help of the electric current, according to Bunsen's method, in quantities of nearly fifty grammes.—A note on impact machines is contributed by M. Sedlaczek.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, Feb. 18.—Annual General Meeting.—John Evans, F.R.S, president, in the chair.—The Secretary read the reports of the Council and of the Library and Museum Committee for the year 1875. The position of the Society was described as very satisfactory, although owing to various extraordinary expenses, the expenditure of the year was considerably in excess of its income. The Society was stated to be in a prosperous state, and the increase in the number of Fellows to be greater than in any previous year. The report also referred to the bequest by the late Sir Charles Lyell of the die of a medal and of the sum of 2,000*l*., a bronze copy of the former and the interest of the latter to be given annually or from time to time by the Council as a mark of honorary distinction to some person or persons who shall be regarded as having aided the progress of Geological Science. It was also announced that Dr. Bigsby, F.R.S., has offered to found a bronze medal to be given in alternate years as an incentive to the study of Geology. The President then presented the Wollaston Gold Medal to Professor Huxley, F.R.S.; the balance of the proceeds of the Wollaston Donation Fund to Mr. J. Gwyn Jeffreys, for transmission to Professor Giuseppe Seguenza, of Messina, F.C.G.S.; the Murchison Medal to Professor Ramsay for transmission to Mr. A. R. C. Selwyn, F.R.S,; the balance of the Murchison Geological Fund to Professor Ramsay for transmission to Mr. James Croll; and the first Lyell Medal and the entire proceeds of the Fund to Professor Morris, F.G.S. The President then proceeded to read his anniversary address, an abstract of which we give on another page. The ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—President: Prof. P. Martin Duncan, F.R.S. Vice-Presidents: Sir P. de M. Grey Egerton, Bart. F.R.S.; R. A. C. Godwin-Austen, F.R.S.; J. W. Hulke, F.R.S.; Prof. A. C. Ramsay, F.R.S. Secretaries: David Forbes, F.R.S.; Rev. T. Wiltshire. Foreign Secretary: Warington W. Smyth, F.R.S. Treasurer: J. Gwyn Jeffreys, F.R.S. Council: H. Bauerman; Rev. T. G. Bonney; W. Carruthers, F.R.S.; Frederick Drew; Prof. P. Martin Duncan, F.R.S,; Sir P. de M. Grey Egerton, Bart., F R.S.; R. Etheridge, F.R.S.; John Evans, F.R.S.; David Forbes, F.R.S.; R. A. C. Godwin-Austen, F.R.S.; Henry Hicks; J. W. Hulke, F.R.S.; J. Gwyn Jeffreys, F.R.S.; Prof. T. Rupert Jones, F.R.S.; J. W. Judd; Prof. J. Morris; Prof. A. C. Ramsay, F.R.S.; Samuel Sharp, F.S.A.; Warington W. Smyth, F.R.S.; Admiral T. A. B. Spratt, F.R.S.; W. Whitaker; Rev. T. Wiltshire, F.L.S.; Henry Woodward, F.R.S.

Linnean Society, Feb. 17.—J. Gwyn Jeffreys, F.R.S., vice-president, in the chair.—Dr. D. D. Cunningham, Mr. W. C. Tuely, Mr. C. M. Wakefield, and Mr. C. F. White were elected Fellows of the Society.—"Additional observations on Ants," by Sir John Lubbock, Bart. In this paper Sir John communicated some further experiments in continuation of those contained in his last memoir. As regards the cases in which when an ant has found a store of food, other ants make their way to it, he commenced by referring to some of his recent observations. To the edge of a board communicating with the nest he fastened three parallel strips of paper about a foot long (G, H, and I). One of these (G) led to a shallow glass tray containing a number of larvæ. The object of this was to ascertain how many ants would find the larvæ for themselves under such circumstances, and as a matter of fact none did so. On the middle strip (H), near the centre, and at right angles with it he placed two strips of paper 2 inches long, one (K) leading to another shallow tray containing larvæ (F), while the other (L) rested on the third strip of paper (I). He then took an ant (*F. nigra*), marked her, and put her on the tray F. She immediately took a larva, and went away to the nest along the strip of paper H. Now it is obvious that by always causing the marked ant to cross from the strip of paper, H, to the larvæ over a particular bridge of paper, K, and if whenever a stranger came, the paper bridges, K and L, were reversed, it would be shown whether the other ants who came to the larvæ had had the direction and position explained to them. In such a case they would go right notwithstanding the interchange of the paper bridges: but if they found their way by tracking the footsteps of the first ant, they would pass over the paper bridge K, and thus be led away from the larvæ to the strip of paper I. The result was that out of 79 strange ants which came up to the point at which the paper bridges diverged, 24 went straight along the strip of paper, 11 took the right bridge to the larvæ, while 44 were misled and went over the paper bridge K away from the larvæ to the strip of paper I. He then slightly altered the arrangement, transfixing one end of the two paper bridges by a pin, and so fastening them by one end to the strip of paper H, the other ends free, that each of them could be turned either to the larvæ or to an empty glass tray. When the marked ant came he turned one paper bridge, K, to the larvæ, the other, L, to the empty tray; while whenever any other ant came he turned the bridges, so that K led to the empty tray and L to the larvæ. Under these circumstances, seventeen ants which came along the strip of paper H, without a single exception, went over the bridge K to the empty tray. He then varied the experiment by leaving the paper bridge K loose as at first; but instead of having a separate bridge L, he cut the strip of paper H into two pieces, H′ and H″. Then when a strange ant was coming, he rubbed his finger two or three times over the bridge K, so as to remove or at least confuse the scent. As soon as the ant had passed over the first part, H′, of the strip of paper H, and had arrived on the part H″, he took up the piece H′ and placed it where the paper bridge L had been in the previous experiments, *i.e.* so as to connect the end of H with the empty glass tray. By this arrangement the bridge K was left in its place, and, on the other hand, there was a bridge which the marked ant had crossed and recrossed as often as K, but which led away from the larvæ. Under these circumstances, out of forty-one ants which found their way to the end of the strip H, and within two inches of the larvæ, fourteen only passed over the bridge K to the larvæ, while twenty-seven went over H′ to the empty tray. Taking these observations altogether, out of 150 ants which came to the end of the strip of paper H, and thus within two inches of the larvæ, only twenty-one took then the right turn and arrived at their destination. These experiments therefore certainly seem to show that when ants flock to a treasure of food which one of them has discovered, they either accompany one another or else track it out by scent. The fact, therefore, is by no means an evidence of any high intelligence, or any complex system of communication, but is merely an instance of instinct, little higher than that which is found in other social animals. On the other hand, that some higher power of communication does exist, seems, however, to be obvious from some of the facts recorded in Sir John's previous paper. In the latter part of his present paper the author narrated a variety of experiments on the senses of ants, and on their power of recognising friends. A lively discussion followed the reading of the paper, in which Messrs. Lowne, Romanes, Mivart, and McLachlan, &c., took part.—Dr. Cobbold gave a notice of and exhibited several specimens of the new human fluke discovered by Prof. J. F. P. McConnell, of Calcutta. This parasite was first described by Dr. McConnell in the *Lancet*, Aug. 21, 1875. Prof. Leuckart, of Leipsic, unaware that the species had been already named, *Distoma sinense*, proposed the name *D. spatulatum* for it, which thus sinks into a synonym. Dr. Cobbold pointed out how the transparency of the specimens permitted all the internal organs to be well seen, and thus their structure could not readily be confounded with any other known species. The Entozoa found by Dr. Kerr, of Canton, and described by Prof. Leidy, did not belong to the above species, but to the great human fluke (*Distoma crassum*) discovered by Prof. Busk. Details of this last-named parasite have just been published in the Society's Journal.—A paper was read by Dr. John Anderson "On the cloacal bladders, and on the peritoneal canals in Chelonia." The former seem first to have been described by Bojanus in *Emys europœa*, but since have received sparse attention. Dr. Anderson has ascertained their presence in a number of Asiatic genera and species, though they do not occur in others, *Testudo*, *Trionyx*, &c., to wit. He suggests these organs may be related to the habits of life, as it appears they are confined to those animals semi-terrestrial and semi-aquatic in habit, the true land and essentially water-living Chelonians being unprovided with them. Although known that some Chelonia draw in and eject water from the cloaca, the precise functions of the pouches in question have not been clearly determined.—The peritoneal canals have received elucidation fron Cuvier, Is. Geoffroy, and Martin, but as to their relations, functions, and homology, Dr. Anderson is at variance with these *savans*. Basing his views on experimental injection and otherwise, he regards them as not connected with the generative functions, but rather agrees with Dumeril and Bibron as to their being accessory and subordinate to transpiration. He believes they have a distinct origin from the Mullerian ducts, and are homologous with the abdominal pore of Selachians and Ganoids.—The chairman called attention to a letter from the Director of the South Kensington Museum, in which the Committee of Council of Education desire the co-operation of the President and Fellows of the Linnean Society toward furnishing objects on loan for the forthcoming Exhibition of Scientific Apparatus.

Anthropological Institute, Feb. 22.—Mr. J. Park Harrison, treasurer, in the chair—The Director, Mr. E. W. Braybrook, read a paper by the Rev. John Earle, M.A., on the Ethnography of Scotland. The author alluded to the great similarity in the physiognomy of the Norwegians and the Scotch as exhibited in photographic portraits, the likeness between the two peoples having also struck Dr. Beddoe. The conquest of the northern parts of Scotland, and especially Caithness, (Icelandic Kata-ness=ship promontory) is celebrated in the Sagas: and the author believed that the "harrying west" of the Danes along the eastern coast of Great Britain extended at least as far as the Firth of Forth. Vigfusson's Icelandic Dictionary supplies materials to illustrate numerous striking features in the Scottish language and the Norsk, *e.g.* bairn, carline, eldine, ettle, fey, (make); gar, greet, (to weep); speer, firth, &c. The Danish and Norsk districts in Scotland are the meeting ground of the great and divergent branches of the Gothic family—the Teutonic and the Scandinavian. In the Scottish language the Norsk element is almost undiluted with Saxon, and we gain from it Ethnological evidence, which recorded history does not distinctly afford. An analysis of the language Mr. Earle believes would bring out additional proofs that it is the permanent expression of the overlapping of the races above alluded to.

Berlin

German Chemical Society, Feb. 14.—A. W. Hofmann, president, in the chair.—E. Paterno and G. Briosi made preliminary communications on hesperidine obtained from oranges; 1,000 oranges yield less than 150 grains of the pure substance.—A. Ladenburg has found that isomeric diamines are acted upon by nitrous acid in very different ways. Parametatoluylendiamine yields a well crystallised body $C_7H_7N_3$, amidoazotoluylene.—T. v. d. Hoff finds that succinic acid obtained in reducing malic acid with HI is optically inactive.—V. Wartha has discovered indigo in commercial litmus.—P. Weselsky described a reaction of phloroglucine. Mixed with nitrate of toluidine and nitrite of potassium it yields a precipitate of the colour of cinnabar.—A. Claus has found that the body until lately known as crotonchloral when treated with cyanide of potassium, yields not only chlorocrotonic acid $C_3H_4ClCO_2H$, but also a bibasic acid $C_3H_4(CO_2H)_2$, and tricarballylic $C_3H_5(CO_2H)_3$.—The same chemist described combinations of sulfo-urea with bichloride of mercury, and with oxalic acid.—R. Hasevcleors, in using Deacon's chlorine-apparatus has remarked that the amount of HCl decomposed, sunk within six weeks from 80 to 2 per cent. He found the hydrochloric acid passing through the apparatus to be contaminated with sulphuric acid, and believes this to be the reason of the deterioration of the process. Sulphuric acid, so he believes, is decomposed into sulphurous acid, and oxygen and the sulphurous acid is reoxidised by retransforming the chlorine into hydrochloric acid:—

$$SO_4H_2 = H_2O + O + SO_2$$
$$SO_2 + Cl_2 + 2H_2O = SO_4H_2 + 2HCl.$$

A support of this view is found in the fact that manufacturers that take great care in introducing hydrochloric free from sulphuric acid, are able to use the process for a comparatively longer period.—M. Neneky, who by the action of formic and acetic acids on guanidine obtained formo-guanamine $C_3N_5H_5$, and aceto-guanamine $C_4N_5H_7$, has also obtained two isomeric bases $C_6N_5H_{11}$ by the action on guanidine on butyric and isobutyric acids. Aceto-guanamine, by taking up one or two molecules of water under the influence of potash, respectively yields guanide $C_4N_4H_6O$; guanamide $C_4N_3H_5O_2$. By oxidation it yields cyanuric acid $C_3N_3H_3O_3$.—E. Bandrowsky, treating guanidine with valerianic acid and caproic acid, obtained the corresponding guanamines, $C_7N_5H_{13}$ and $C_8N_5H_{15}$.

Paris

Academy of Sciences, Feb. 14.—Vice-Admiral Paris in the chair.—The deaths of MM. Andral and Seguier were announced.—The following papers were read:—On the ethers of hydracids, by M. Berthelot.—On the formation of amides, by M. Berthelot.—On hyposulphite of potash, by M. Berthelot.—Memoir on the approximation of functions of very large numbers and on an extensive class of developments in series (second part), by M. Darboux.—Vibrations of a homogeneous solid in equilibrium of temperature, by M. Felix Lucas.—On the movements of the heart when it is submitted to artificial excitations, by M. Marey. The results obtained show that the heart is refractory to excitation during the greater part of its systolic phase. The systole produced (by excitation) is greater the longer its interval from the spontaneous systole which precedes it. After each systole produced, there is a compensating repose which restores the temporarily altered rhythm of the heart. This is important as confirming a law the author believes he has established, viz., that the work of the heart tends to remain constant.—On deviations from the laws relating to gases, by M. Mendeléeff.—On isomerous rosanilines, by M. Rosenstiehl. There are three of these, one derived from 1 molecule of aniline and 2 molecules of toluidine; another, 1 of aniline and 2 of pseudo-toluidine; the third, 1 of aniline, 1 of toluidine, and 1 of pseudo-toluidine; the latter constitutes, for the most part, commercial fuchsine.—On the optical inactivity of the reducing sugar contained in commercial products, by MM. Aimé Girard and Laborde.—On a new element in the determination of chimi-calories, by M. Maumenè. Very various liquids undergo a molecular alteration (readily revealed by chemical action) without their nature being changed; the purely physical influence of heat gives them a sort of temper (*trempe*), during which their chemical actions produce extraordinary numbers of chimi-calories. Olive oil recently heated to about 300° behaves no longer like its former self when treated with hot acid, but it is not perceptibly altered in colour, odour, or density.—On a new acid pre-existing in the fresh milk of mares, by M. Duval. It appears to be distinct from hippuric acid, and the author proposes to call it *equinic* acid.—On the aptitude of oysters for reproduction from the first year, by M. Gerbe. Observation shows this to be a fact. Among these precocious mothers there are some whose shell, in transverse diameter, measures hardly 25 mm. Hence the prosperity of the reproducing portion of a natural oyster bed, does not depend only on the presence of large oysters. The quantity of eggs, indeed, is generally in proportion to the size of the oyster. Many oysters, especially the young, propagate twice in the season, under favourable conditions. The laying of eggs occurs at long intervals, possibly corresponding to lunar phases.—Reply to a note of M. Arm. Gautier, relative to the *rôle* of carbonic acid in the coagulation of blood, by MM. Mathieu and Urbain.—Description of the diplometer, by M. Landolf. This is an instrument for measuring the diameter of an object at a distance and independently of its movements.—On the origin and mode of generation of atmospheric whirlwinds, and on the unity of direction of their gyratory motion, by M. Cousté. The whole mechanism of whirling movements in the atmosphere depends on two causes, gravity and heat; the weight of the air drives vertically from below upwards the less dense water-vapour which the heat has produced; and further, the weight of the air causes this gas to be precipitated (in horizontal, or at least *inclined* directions into the vacuum which the vapour tends to leave behind it in rising.

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Erratum.—Vol. xiii. p. 328, last line, for *him* read *me*.