THURSDAY, MARCH 7, 1872

A FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

IN France there is at the present time a movement of regeneration in the scientific world, slow indeed, and difficult to be seen through the troubles on the surface, but the evidence of it is incontestable. The actual activity is great; publications of every kind appear, some quite new, as the *Journal de Physique*, the *Archives de Zoologie;* others improved and extended, as the *Annales de l'Ecole Normale*. The *Comptes Rendus* of the Paris Academy, which are the weekly *résumé* of French science, have rarely been so full of important memoirs, while research, almost dead to England, promises regeneration for French science.

To take a recent example of this activity, we may cite about fifty notices relative to the aurora borealis of last month, coming from every part of France. This amount of attention paid to a phenomenon which, a few years ago, would have excited nothing more than a mere curiosity, evidences the actual aspirations connected with, and a natural taste for, scientific subjects. But what must specially strike the English scientific world is the recent foundation of a French Association for the Advancement of Science, on the model of the British Association, without any other modifications than those which must result from the different characters of the two nations.

Though this proposal has not reached its complete extension (no publicity having been as yet given to it) it is possible, from the rapidity with which the working committee was constituted, the large amount of money collected, and the sympathies expressed on all sides, to predict for the younger sister of the British Association a great success.

The proposed statutes, which have been drawn up and provisionally adopted at a series of meetings at which MM. Balard, Berthelot, Briot, Broca, Claude Bernard, Combes, Cornu, Decaisne, Delaunay, Descloiseaux, De Luynes, Dumas, Friedel, P. Gervais, A. Girard, G. Hachette, Lacaze-Duthiers, Laugier, Levasseur, Loewy, Marié-Davy, V. Masson, Pasteur, Serret, Tisserand, and Wurtz were present, are as follows :—

ART. I.—The Association proposes to favour by every means in its power the progress of the sciences, their practical application, and the diffusion of scientific knowledge. For this purpose it will exercise its influence principally by meetings, conferences, and publications; by gifts of instruments or money to persons engaged in researches, observations, or experiments, scientific enterprises which it would have approved or provoked. It appeals to all those who consider the culture of the sciences as necessary to the greatness and prosperity of France.

ART. II.—The Association is established with a capital divided into shares of 500 francs each, subscribed by members who take the title of founders. It will commence its operations as soon as 200 of these shares, forming a capital of 100,000 francs, shall have been subscribed.*

ART. III.—The Association shall consist of founders and ordinary associates, who shall pay an annual subscription of 20 francs. This subscription can always be compounded by the payment of the sum of 200 francs once for all.

ART. IV.—The number of founders or associates is unlimited, and all enjoy the same privileges. The names of the founders shall, however, always appear at the head of the lists, and these members receive gratuitously and for ever all the publications of the Association, as many copies as they have subscribed shares of 500fr.

ART. V.—The seat of the Council of the Association shall be at Paris.

ART. VI.—Each year the Association shall hold in one of the towns of France a general session, the duration of which shall be eight days.

ART. VII.—In the general session the Association shall be divided into sections, of which the number and functions shall be fixed by the general assembly on the proposition of the Council. These sections shall be attached to the four groups of Mathematical, Physical and Chemical, Natural, and Economical and Statistical science. Every member of the Association shall choose each year the section to which he wishes to belong. He can nevertheless take part in the work of the other sections, but only with consultative voice (*voix consultative.*)

ART. VIII.—The bureau of the Association is composed :—1, of the president and secretary; 2, of the presidents and secretaries of sections; 3, of the treasurer and the librarian.

ART. IX.—The Association shall be managed gratuitously by a Council composed—1, of the bureau of the association; 2, of members elected in the general assembly to the number of three by each section.

ART. X.—At the commencement of each session the presidents, vice-presidents, and secretaries of the sections are nominated directly by a relative majority of the sections.

At the end of each session, the Association, united in general assembly, shall name the town where the following session shall take place, fix a programme for that session, and nominate by relative majority the president and secretary for the following year, and also the members of the Council.

The president and secretary shall be taken in turn from each of the four sections. If either is prevented from attending, he shall be replaced by one of the presidents or secretaries of the divisions of the section to which he may belong.

ART. XI.—The Council charged with the organisation of the session in the town selected can for that purpose elect an honorary president.

ART. XII.—All members of the Association are asked to take part in elections by voting either in person or by letter (*par correspondence*).

ART. XIII.—The Council represents the Association. It has full power to carry on and administer the social business, both active and passive. It shall receive all funds belonging to the Association, of whatever kind they may be. It shall invest in Government securities the funds arising from the shares subscribed by the founders, and from the compounding of annual subscriptions by the associates. It shall superintend the expenditure of the disposable funds voted by the Association on its proposal. It shall make all rules necessary for maintaining internal order and the execution of the present statutes. It shall convoke the Association, and arrange the programme of the meeting, in conformity with deliberations made in the general assembly.

The Council shall nominate and constitute the special committees for the funds for encouragements, for publications, and for conferences.

The Council shall deliberate in due form and by the majority of members present; nevertheless no resolution shall be valid unless it shall have been deliberated upon in the presence of one-fourth, at least, of the members of the Council.

ART. XIV.—The Council shall prepare annually the budget of expenses of the Association, and shall read in the annual general session a detailed account of receipts and expenses of work themselves (*de l'enercice écoulé*).

ART. XV.—The statutes can be modified on the proposition of the Council, and by a majority of two-thirds voting in the general assembly. The proposed modifications shall be indicated beforehand in the Convocatory letters addressed to all members of the Association.

PROPOSED SECTIONS

1st Section—*Mathematical Science*

1st, Division of Mathematics, Astronomy, and Geodetical

* This amount has been exceeded some weeks since. It was subscribed by scientific men, and by the greater number of the councils of the railway, industrial, and financial companies.

Science; 2nd Mechanics; 3rd, Navigation; 4th, Civil and Military Engineering.

2nd Section—*Chemical and Physical Science*

5th, Physics; 6th, Chemistry; 7th, Meteorology and Physics of the Globe.

3rd Section—*Natural Sciences*

8th, Zoology and Zootechny; 9th, Botany; 10th, Geology and Mineralogy; 11th, Medicine.

4th Section—*Economic Sciences*

12th, Agriculture (*Agronomie*); 13th, Ethnography and Geography; 14th, Statistics.

We are told that certain modifications may be introduced before the final constitution of the Association, but they are not likely to change the general character of the institution.

Amongst the promoters of this Association are to be found the names most celebrated in French science, showing that this scientific movement is a general one, and answers to a pressing want.

A peculiar feature will be remarked: the general spirit of the statutes denotes a very decided tendency to *decentralisation*. Up to the present time French science has had the reverse tendency,—to attract to Paris all the intelligent strength of the nation. The result, most excellent for Paris, which constitutes one of the greatest scientific centres in the world, has been very disadvantageous for the country. The provincial *facultés* (local universities) have been deprived of the most important of their members, and are actually very far from answering to the scientific standard of the metropolis. If we add now that the *Ministère de l'Instruction Publique* not only has insufficient funds for these institutions of higher instruction, but considers the *facultés* as sources of revenue by the granting of degrees, it will be understood that it is the right time to act vigorously to raise the taste for science in the parts of the country remote from the capital.

Too much encouragement cannot be given to the founders of the French Association in their task of decentralising science in France. The first result will be to create real scientific centres, vigorous with a new life, and diffusing a great activity. It cannot be objected that the genius of the nation is opposed to such a decentralisation, and that all aspirations must necessarily converge towards Paris. This is an error. The town of Montpellier gives the example of a Faculté de Médecine, of which the reputation is scarcely inferior to the Paris *faculté*. It is equally certain that Toulouse the town of *Jeuxfloraux*, Lyons, Marseilles, Clermont, and many others, under a vigorous impulse, could also become great scientific centres. To aim at this object, nothing will be better than to show every year the whole scientific *corps* of Paris, the scientific *Etat-major* transporting itself to a remote city or town, liberally giving lectures and conferences, and promoting researches and experiments. Thus the metropolis will greatly help the scientific renovation, and will show that it wishes not to attract to itself the whole force and consideration, but to diffuse its own energy over the whole country.

It is probable that the first meeting will be held this year at Lyons, the second town of France, at the end of August or the beginning of September. To the interest of the meeting would be added the attraction of a great industrial exhibition.

We cannot do otherwise than wish a great success to the French Association. We are happy to see that all parties are uniting in their exertions in such a direction; that a good number of associates, independent or belonging to scientific societies, are giving in their adhesion to the new association. Amongst the congratulations which the Association ought to receive at its birth, no doubt one of the first will be addressed by the British Association. This will be for England both a duty and an honour. A nation must always be happy to be valued and proud to be imitated.

QUETELET'S CONTRIBUTIONS TO THE SCIENCE OF MAN

Physique Sociale, ou Essai sur le Développement des Facultés de l'Homme. Par Ad. Quetelet. (Brussels, 1869.)

Anthropométrie, ou Mesure des différentes Facultés de l'Homme. Par Ad. Quetelet. (Brussels, 1870.)

TWO lines of research into the Science of Man, of the highest moment as well in theoretical Anthropology as in practical Ethics and Politics, both to be always associated with the name of Quetelet, are now discussed at large in his Social Physics and Anthropometry. The two great generalisations which the veteran Belgian astronomer has brought to bear on physiological and mental science, and which it is proposed to describe popularly here, may be briefly defined. First, he has been for many years the prime mover in introducing the doctrine that human actions, even those usually considered most arbitrary, are in fact subordinate to general laws of human nature; this doctrine, maintained in previous publications, especially in the earlier edition of the first-named work some thirty-seven years ago, is now put forth in its completest form. Second, he has succeeded in bringing the idea of a biological type or specific form, whether in bodily structure or mental faculty, to a distinct calculable conception, which is likely to impress on future arguments a definiteness not previously approached.

The doctrine of the regularity and causality of human actions was powerfully stated some fifteen years ago by Mr. Buckle in the introduction to his "History of Civilisation." Buckle is here essentially the exponent of Quetelet's evidence, from which, indeed, as a speculative philosopher he draws inferences more extreme than those of his statistical teacher. To Quetelet is due the argument from the astonishing regularity from year to year in the recurrences of murders and suicides, a regularity extending even to the means or instruments by which these violent acts are committed; his inference being broadly "that it is society which prepares the crime, the criminal being only the instrument which executes it." From various other sources Buckle brought together other pieces of evidence, especially one which is now quoted by all who discuss the subject, the regularity from year to year of letters posted, whose writers forget to direct them. It may by this time be taken as proved by such facts that each particular class of human actions may be estimated, and to a great extent even predicted, as a regular product of a definite social body under definite conditions. To quote another luminous instance of this regularity of

action, M. Quetelet gives a table of the ages of marriage in Belgium (Phys. Soc. i. p. 275). Here the numbers of what may be called normal marriages, those between men under 45 with women under 30, as well as of the less usual unions where the women are between 30 and 45, show the sort of general regularity which one would expect from mere consideration of the circumstances. The astonishing feature of the table is the regularity of the unusual marriages. Disregarding decimals, and calculating the approximate whole numbers in their proportion to 10,000 marriages, the table shows in each of five five-year periods from 1841 to 1865, 6 men aged from 30 to 45 who married women aged 60 or more, and 1 to 2 men aged 30 or less who married women aged 60 or more. M. Quetelet may well speak of this as the most curious and suggestive statistical document he has met with. These young husbands had their liberty of choice, yet their sexagenarian brides brought them up one after the other in periodical succession, as sacrifices to the occult tendencies of the social system. The statistician's comment is, "it is curious to see man, proudly entitling himself King of Nature and fancying himself controlling all things by his free-will, yet submitting, unknown to himself, more rigorously than any other being in creation, to the laws he is under subjection to. These laws are co-ordinated with such wisdom that they even escape his attention."

The admission of evidence like this, however, is not always followed by the same philosophical explanation of it. Buckle finds his solution by simply discarding the idea that human action "depends on some capricious and personal principle peculiar to each man, as free-will or the like;" on the contrary, he asserts "the great truth that the actions of men, being guided by their antecedents, are in reality never inconsistent, but, however capricious they may appear, only form part of one vast scheme of universal order, of which we, in the present state of knowledge, can barely see the outline." M. Quetelet's argument from the same evidence differs remarkably from this. His expedient for accounting for the regularity of social events without throwing over the notion of arbitrary action, is to admit the existence of free-will, but to confine its effects within very narrow bounds. He holds that arbitrary will does not act beyond the limits at which science begins, and that its effects, though apparently so great, may, if taken collectively, be reckoned as null, experience proving that individual wills are neutralised in the midst of general wills (p. 100). Free-will, though of sufficient power to prevent our predicting the actions of the individual, disappears in the collective action of large bodies of men, which results from general social laws, which can accordingly be predicted like other results regulated by natural laws. We may perhaps apprehend the meaning of Quetelet's views more clearly from another passage, where, to show how apparently isolated events may be really connected under some wide law, he compares single facts to a number of scattered points, which seem not related to one another till the observer, commanding a view of a series of them from a distance, loses sight of their little accidents of arrangement, and at the same time perceives that they are really arranged along a connecting curve. Then the writer goes on to imagine, still more suggestively, that these points might actually be tiny animated creatures, capable of free action within a very narrow range, while nevertheless their spontaneous movements would not be discernible from a distance (p. 94), where only their laws of mutual relation would appear. M. Quetelet can thus conciliate received opinions by recognising the doctrine of arbitrary volition, while depriving it of its injurious power.* His defence of the existence of free-will is perhaps too much like the famous excuse of the personage who was blamed for going out shooting on the day he had received the news of his father's death, and who defended himself on the ground that he only shot very small birds. But it is evident that the statistics of social regularity have driven the popular notion of free-will into the narrow space included between Quetelet's restriction and Buckle's abolition of it. In fact, no one who studies the temper of our time will deny the increasing prevalence of the tendency of the scientific world to reject the use of the term free-will in its vulgar sense, that of unmotived spontaneous election, and even to discourage its use in any other sense as apt to mislead, while its defenders draw their weapons not so much from observation of facts as from speculative and dogmatic philosophy.

To those who accept the extreme principle that similar men under similar circumstances must necessarily do similar acts; and to those, also, who adopt the notion of free-will as a small disturbing cause which disappears in the large result of social law, the regularity of civilised life carries its own explanation. Society is roughly homogeneous from year to year. Individuals are born, pass on through stage after stage of life, and die; but at each move one drops into another's place, and the shifting of individuals only brings change into the social system, so far as those great general causes have been at work which difference one age from another, the introduction of different knowledge, different principles, different arts, different industrial materials and outlets. The modern sociologist, whatever his metaphysical prepossessions, looks at society as a system amenable to direct cause and effect. To a great extent his accurate reckonings serve to give more force and point to the conclusions of rough experience; to a great extent, also, they correct old ideas and introduce new aspects of social law. What gives to the statistical method its greatest scope and power is that its evidence and proof of law applies indiscriminately to what we call physical, biological, and ethical products of society, these various effects acting and re-acting on one another. A few instances may be given to show the existence of the relations in question, without attempting to show their precise nature, nor to trace the operation of other determining causes.

Thus, for instance, the mode of life affects its length Statistics show that the mortality of the very poor is about half as much again as the mortality of the very rich; while as to the influence of professions, it appears that in Germany only twenty-four doctors reach the age of seventy as against thirty-two military men and forty-two theologians. The propensity to theft bears a distinct relation to age; thus the French criminal statistics estimate the propensity to theft between the ages of twenty-one and twenty-five, as being five-thirds as much as between the ages of thirty-five and forty. The

* In regard to the relation of statistics to the doctrine of fatalism, see Dr. Farre's "Report on the Programme of the Fourth Session of the Statistical Congress."

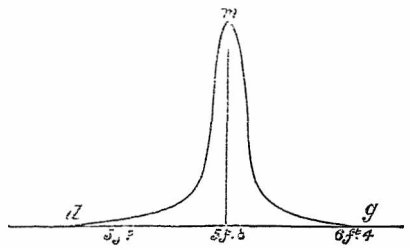
amount of criminality in a country bears a relation, indirect and as yet obscure, but unmistakeable, to its education, or rather, to its want of education. In France, in 1828-31, the constant percentage of accused persons was about as follows: could not read or write, sixty-one; imperfectly, twenty-seven; well, twelve. The comparison of this group of numbers with those taken lately in England shows a great change of proportion—evidently resulting from the wider diffusion of education; but the limitation of crime to the less-educated classes is even more striking: cannot read or write, thirty-six; imperfectly, sixty-one; well, three. Again, for an example of connection of physical conditions with moral actions, we may notice a table, showing how the hours of the day influence people who hang themselves. (Phys. Soc. ii. 240.) The maximum of such cases, 135, occurred between six and eight in the morning; the number decreased slightly till noon, and then suddenly dropped to the minimum; there being 123 cases between ten and twelve o'clock, against only 32 between twelve and two o'clock. The number rose in the afternoon to 104 cases between four and six, dropping to an average of about 70 through the night, the second minimum, 45, being between two and four o'clock in the morning. Here it is impossible to mistake the influences of the periods of the day; we can fancy we see the poor wretches rising in the morning to a life of which the misery is beyond bearing, or can only be borne till evening closes in; while the temporary relief of the midnight sleep and the midday meal are marked in holding back the longing to self-destruction. Madness varies with the season of the year: the maximum being in summer, and the minimum in winter (p. 187); a state of things which seems intelligible enough. Again, it is well known in current opinion that more children are born in the night than in the day; in fact, there are about five night-born against four day-born, the maximum being about midnight, the minimum a little before noon (i. p. 208). Why this is no one yet knows; it is a case of unexplained law. But another not less curious law relating to births seems to have been at last successfully unravelled. In Europe about 106 boys are born to every 100 girls. The explanation appears to depend on the husband being older than the wife; which difference again is regulated by prudential considerations, a man not marrying till he can maintain a wife. In connection with this argument it must be noticed that illegitimate births show a much less excess of male children (p. 168). Here, then (if this explanation may be accepted), it appears that a law which has been supposed to be due to purely physiological causes is traceable to an ultimate origin in political economy.

The examples brought forward by Quetelet, which thus show the intimate relation between biological and ethical phenomena, should be pondered by all who take an interest in that great movement of our time—the introduction of scientific evidence into problems over which theologians and moralists have long claimed exclusive jurisdiction. This scientific invasion consists mainly in application of exact evidence in place of inexact evidence, and of proof in place of sentiment and authority. Already the result of the introduction of statistics into inquiries of this kind appears in new adjustments of the frontier line between right and wrong, as measured under our modern social conditions. Take, for instance, the case of foundling hospitals, which provide a "tour," or other means for the secret reception of infants abandoned by their parents. It has seemed and still seems to many estimable persons an act of benevolence to found and maintain such institutions. But when their operation comes to be studied by statisticians, they are found to produce an enormous increase in the number of exposed illegitimate children (Phys. Soc. i. 384). In fact, thus to facilitate the safe and secret abandonment of children is to set a powerful engine at work to demoralise society. Here, then, a particular class of charitable actions has been removed, by the statistical study of its effects, from the category of virtuous into that of vicious actions. An even more important transition of the same kind is taking place in the estimation of almsgiving from the ethical point of view. Until modern ages, through all the countries of higher civilisation, men have been urged by their teachers of morality to give to the poor, worthy or unworthy; the state of public opinion being well exemplified by the narrowing of the word "charity" from its original sense to denote the distribution of doles. Yet, when the statistics of pauperism were collected and studied, it was shown that indiscriminate almsgiving is an action rather evil than good, its tendency being not only to maintain, but actually to produce, idle and miserable paupers. In our time a large proportion of the public and private funds distributed among the poor is spent in actually diminishing their industry, frugality, and self-reliance. Yet the evil of indiscriminate almsgiving is diminishing under the influence of sounder knowledge of social laws, and genuine charity is more and more directed by careful study of the means by which wealth may be spent for the distinct benefit of society. Such examples as these show clearly the imperfection and untrustworthiness of traditional, or what is called intuitive morality, in deciding on questions of right and wrong, and the necessity of appealing in all cases to the best attainable information of social science to decide what actions are really for or against the general good, and are therefore to be classed as virtuous or vicious.

Moreover, it is not too much to say that the comparatively small advance which moral science has made since barbaric ages has been due to the repugnance of moralists to admit, in human action, the regular causality which is the admitted principle of other parts of the action of the universe. The idea of the influence of arbitrary will in the individual man has checked and opposed the calculations which now display the paramount action of society as an organised whole. One point in M. Quetelet's doctrine of society requires a mention for its practical bearing on morals. There has seemed to some to be an immoral tendency in his principle that virtuous and vicious acts are products, not merely of the individual who does them, but of the society in which they take place, as though the tendency of this view were to weaken individual responsibility, and to discourage individual effort. Yet, when properly understood, this principle offers a more strong and definite impulse to the effort of society for good and against evil, than the theory which refers the individual's action more exclusively to himself. M. Quetelet's inference from the regular production of a certain amount of crime year by year from

a society in a certain condition, is embodied in his maxim that society prepares the crime and the criminal executes it. This should be read with a comment of the author's. "If," he says, "I were to take up the pavement before my house, should I be astonished to hear in the morning that people had fallen and hurt themselves, and could I lay the blame on the sufferers, inasmuch as they were free to go there or elsewhere?" Thus every member of society who offers a facility to the commission of crime, or does not endeavour to hinder its commission, is, in a degree, responsible for it. It is absurd to suppose that the crimes in great cities are attributable altogether to the free agency of the poor wretches who are transported or hung for them. The nation which can and does not prevent the existence of a criminal class is responsible collectively for the evil done by this class. This we can see plainly enough, although the exact distribution of the responsibility among the different members of society may be impossible to determine. Such a theory, of course, casts aside the revenge-theory of criminal law, assimilating the treatment of criminals to the operation of a surgeon healing a diseased part of the body, if possible, or, if not, rendering it harmless or removing it.

The wealthy and educated classes, whose lives seem to themselves as free from moral blame as they are from



legal punishment, may at first hear with no pleasant surprise a theory which inculpates them as sharers in the crimes necessarily resulting from the state of society which they are influential in shaping. Yet this consideration is by no means one of mere hopeless regret, for coupled with it is the knowledge that it is in their power, by adopting certain educational and reformatory measures, so to alter the present moral status of society as to reduce the annual budget of crime to a fraction of its present amount. Thus the doctrine that the nation participates in and is responsible for the acts of its individual members is one which widens the range of duty to the utmost. The labours of M. Quetelet in reducing to absolute calculation this doctrine of the solidarity of human society, entitle him to a place among those great thinkers whose efforts perceptibly raise that society to a higher intellectual and moral level. Here, as everywhere, the larger comprehension of the laws of nature works for good and not for evil in the history of the world.

Some slight account has now to be given of M. Quetelet's doctrine of typical forms, as displayed in the "homme moyen," or "mean man," of a particular nation or race. This is no new theory; but since the publication of the "Physique Sociale" in 1835, the author has been at work extending and systematising it, his last results being shown in the present works. First, it must be pointed out that the term "homme moyen" is not intended to indicate what would be popularly meant by an "average man." An average or arithmetical mean of a number of objects may be a mere imaginary entity, having no real representative. Thus, an average chessman, computed as to height from the different pieces on the board, might not correspond to any one of the actual pieces. But the "homme moyen" or central type of a population really exists; more than this, the class he belongs to exceeds in number any other class, and the less nearly any other class approaches to his standard the less numerous that class is, the decrease in the number of individuals as they depart from the central type conforming to a calculable numerical law. The "mean man" (the term may probably be adopted in future researches, and when technically used its popular meaning will cease to interfere with this special one)—the "mean man" thus stands as a representative of the whole population, individuals as they differ from him being considered as forms varying from his specific type.

To realise a conception which even among anthropologists has scarcely yet become familiar, it is desirable to show by what actual observations M. Quetelet was led to the discovery of his principle. When a large number of men of a practically homogeneous population are measured, and arranged in groups accordingly, it becomes evident that the individuals are related to one another by a law of distribution. A central type is represented by the most numerous group, the adjoining groups becoming less and less numerous in both directions. Thus, on classifying the measured heights of some 26,000 American soldiers of the Northern army during the late war, the proportionate number of men to each height was ascertained to be as follows (Phys. Soc. i. p. 131; Anthropom. p. 259):—

Height, inches	60	61	62	63	64	65	66	67	68
No. of men in 1,000 .	1	1	2	20	48	75	117	134	157
Height, inches	69	70	71	72	73	74	75	76	
No. of men in 1,000 .	140	121	80	57	26	13	5	2	

Here it is seen that the mean man is a little under 5 ft. 8 in. in height, the numbers of men shorter and taller diminishing with evident regularity, down to the few representatives of the very short men of 5 ft. and under, and the very tall men of 6 ft. 4 in. and over. The law of relation of height to numerical strength is shown graphically by the binomial curve figured above, where the abscissæ (measured from an origin on the left) represent the heights of the men, and the ordinates the relative numbers of men corresponding to each height. The maximum ordinate, representing the number of mean men, is at m = about 5 ft. 8 in., the ordinates on both sides diminishing almost to nothing as they reach the dwarfish and gigantic limits d and g, and vanishing beyond.

Again, measurement round the chest, applied to the soldiers of the Potomac army, shows a similar law of grouping (Phys. Soc. ii. 59; Anthropom. p. 289).

Round chest, inches	28	29	30	31	32	33	34	35
No. of men in 1,000 . . .	1	3	11	36	67	119	160	204
Round chest, inches	36	37	38	39	40	41	42	
No. of men in 1,000 . . .	166	119	68	28	13	4	1	

Here the mean man measures about 35in. round the chest, the numbers diminishing both ways till we reach the few

extremely narrow-chested men of 28in., and the few extremely broad-chested men of 42in. These two examples may represent the more symmetrical cases of distribution of individuals on both sides of a central type, as worked out by M. Quetelet from various physical measurements applied to large numbers of individuals. Here the tendency to vary is approximately equal in both directions. Where the tendency to vary is perceptibly different in the two directions the curve loses its symmetry, as in the figures representing the weights of women at different ages (Anthropom. p. 349), and the number of marriages of men and women at different ages (Phys. Soc. i. 272). The actual series of numbers given by observation are placed beside series computed according to the law of the expanded binomial, the same which is applied in the theory of probabilities to such calculations as that of the proportionate distribution of less probable events on each side of a most probable maximum term, the distribution of errors of observation of a single object, and of accidental variations in general. It is the closeness of approximation between the observed and calculated series of variations, computed not only as to the dimensions, but the actions of man, which gives to M. Quetelet's theory its remarkable definiteness and precision.

The diagram of statures here figured, which may be looked upon as representing a nation measured in one particular way, at once impresses on the mind a conception of a race-type materially differing from the vague notions hitherto current. It is seen that individual men of different statures are required to constitute a nation, but they are required in less and less proportion as they depart in excess or defect from the central type. The nation is not even complete without its dwarfs and giants. In fact, if all the monstrously short and tall men of a particular country were put out of sight, and the census of the population taken according to stature, the national formula thence deduced would enable a statistician to reckon with considerable accuracy how many dwarfs and giants of each size had been removed.

M. Quetelet's investigations further prove, or tend to prove, that similar laws of variation from the central type govern the distribution of individuals classed according to other bodily dimensions, and also according to physical qualities such as weight and strength, it being borne in mind that the particular expressions with their descriptive curves differ for the various qualities or faculties of man, being also in some cases much less symmetrical than in others. An absolute coincidence of the series of observed facts with the numerical law chosen to express them would be too much to expect; it is a great deal to obtain even a rough coincidence. For instance, when the strength of a number of men is estimated by a dynamometer, the maximum number showed 140 to 150 degrees on the scale, the number of weaker and stronger men being both fewer from this point, groups following approximately the proportions of the coefficients of a binomial of the 6th order; the numbers are reduced as follows from the table (Anthropom. p. 365) :—

Renal force, degrees . .	90	100–110	120–130	140–150	160–170
No. of men in 64 . . .	1	8	14	20	15
Binom. coeff.	1	6	15	20	15

Renal force, degrees	180–190	200
No. of men in 64 . . .	6	1
Binom. coeff.	6	1

In the various numerical examples here given, the element of age is not introduced, the ages of the individuals being calculated or taken as uniform. The problem of variation of numerical distribution of a population at different ages is treated by M. Quetelet in a comparatively simple case, that of the stature-curve. Here a curve approximating to a parabola is laid down, the ages of man from birth onward being measured along its axis; each double ordinate of this curve forms the base on which a binomial curve is erected perpendicularly, the vertices of these curves forming a curve of mean stature, of the nature of a curve of mortality (Anthropom. p. 264). How far M. Quetelet may succeed in his contemplated purpose of carrying his method from the physical into the intellectual and moral nature of man, it is premature to judge.

Without entering into the more intricate and difficult problems opened by this theory of central types, it is evident that the bearing of its main conception on the problems of anthropology and biology in general is highly important. Some able anthropologists have accepted the theory of the mean or central standard as a basis for the comparison of races, but this line of research is still in its infancy. In M. Quetelet's last volume a principle is worked out which serves as a bridge between the old and new methods. His experience is that in a well-marked population no extraordinary number of observations is required for the determination of the mean man. In former ages, one result of the national type being so preponderant in number and so easily recognisable was that the bodily measurements of any man of ordinary stature and proportions could be trusted to give, with reasonable accuracy, the standard measures of the nation, such as the foot, cubit, fathom, &c. In the same manner M. Quetelet finds a small number of selected individuals sufficient for ascertaining the standard national proportions of the human body, male and female, from year to year of growth; his tables, founded for the most part on Belgian models, are given in an appendix. This method is applicable to the purposes of general anthropology. Thus a traveller, studying some African or American race, has to select by mere inspection a moderate number of typical men and women, by comparison of whose accurately admeasured proportions he may approximate very closely to a central race-type.* It is not necessary to dwell on the obvious difficulties of connecting the standard types of mixed nations with the races composing them. The stature-curve of England differs visibly in proportions from that of Italy, the measurements of Scotch and American soldiers show very different mean and extreme terms, and the problems of race underlying these differences are of a most complex character, the more so when the consideration is introduced of the race-type varying within itself from century to century. M. Quetelet is naturally apt, when expressing his views in an exordium or a peroration, to draw a good deal on the anticipated future results of his admirable method; but in judging of the value of his doctrine of central types, the best criterion is his actual success in reducing the observed facts of nature to numerical

* Thus General Lefroy's measurements of thirty-three Chipewyan Indians ("Journal of the Ethnological Society," vol. ii. p. 44, 1870) are sufficient to determine the stature of the mean man as about 5 ft. 7 in., the number of individuals in this maximum group being 8. It is even possible to guess from this small number of measurements the numerical law of variation in the tribe, the series of groups from 5 ft. 3 in. to 5 ft. 11 in being as follows :— 1, $1\frac{1}{2}$, $2\frac{1}{2}$, 6, 8, $4\frac{1}{2}$, $4\frac{1}{2}$, 3, 1.

calculation. The future must show how far it will be possible to apply to the theory of species the definition of central specific forms, from which varieties calculably diminish in numbers as they depart in type.

E. B. TYLOR

OUR BOOK SHELF

Magnetism. By Sir W. Snow Harris and H. M. Noad. (London: Lockwood and Co.)

THIS is a good book, and we are glad to see the subject of magnetism fully treated in a popularly written text-book. It is a second edition of Sir William Snow Harris's rudimentary treatise, with considerable and important additions by the editor. The part of chief importance which is added is Chapter viii., which deals with the more recent progress of terrestrial megnetism. This chapter consists of thirty pages, and the author has managed to condense into that space a wonderfully large amount of interesting, useful, and accurate information on the subject. In so short a space we must be content with results rather than with particulars, but the matter contained in this chapter, in point of importance, accuracy, and exhaustiveness, places the present treatise, as far as terrestrial magnetism is concerned, much before any similar book with which we are acquainted. The correction of the compass in iron ships is entered into in the last chapter. The telegraph is scarcely touched upon, but this perhaps rather belongs to a treatise on electricity. We have a chapter on theories of terrestrial magnetism. The theory of Gauss should never be classed, as it is here, and indeed as it is generally classed, along with theories like those of Halley or Hanstein, or with such things as electro-magnetic theories and the like. The word "theory" in these cases means quite a different thing from what it means when applied to Gauss's investigations. Hanstein and the like all make some physical hypothesis, which may or may not be the case; but Gauss makes no such assumption at all, except in so far as he supposes that the needle at all parts of the earth's surface is affected by forces due to the same origin, and varying inversely as the square of the distance, which has been experimentally proved to be the law according to which magnetic forces act. He then shows how the effect on a needle can be expressed in terms of an infinite series which is necessarily mathematically convergent and true, and he then uses an approximation to that series, which approximation is justified fully by experiments similar to those made by the late Prof. Forbes at the top and bottom of the Faulhorn. Gauss's theory, then, is a truly scientific theory, inasmuch as it involves no unjustified physical hypothesis, but is a logical deduction from observed facts and established principles, and in this differs radically from the other theories which are too often classed with it. Dr. Noad has been so successful in Chapter viii. that we cannot help wishing he had introduced a chapter also on this subject. JAMES STUART

The Amateur's Flower-Garden: a Handy Guide to the Formation and Management of the Flower Garden and the Cultivation of Garden Flowers. By Shirley Hibberd. Illustrated with coloured plates and wood engravings. (London: Groombridge and Son, 1871.)

MR. HIBBERD is a practised writer on gardening subjects, though his books have not much claim to be considered as scientific treatises, but rather as pretty gift-books to lie on the drawing-room table and give to its furniture a *quasi*-scientific air. That they have their use cannot be doubted, but it is not a very high one. The worst part of this book is the illustrations. From the letter-press may be doubtless culled some useful hints as to the planting and management of a flower-garden, though we do not think it equal in this respect to some other works, such as those by Mr. Robinson, which are less under the trammels of time-honoured prejudices and superstitions. But many of the illustrations, including some of the woodcuts and nearly all the coloured plates, are simply atrocious. The drawings of a show pelargonium (p. 80), pansy (p. 45), ranunculus (p. 156), carnation (p. 117), and some others, are mere caricatures, and unworthy of a place in any work which bears the least pretensions to a scientific character.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Survival of the Fittest

I HAD designed sending a note to you, critical of the abstract of my paper on "The Laws of Organic Development," republished from the *American Naturalist* in one of your recent issues, before I read the remarks of Mr. Spencer in your number of February 1.

If Mr. Spencer will examine the Essay itself (for sale by McCalla and Stavely, 237, Dock Street, Phila., or Naturalists' Book Agency, Salem, Mass.*) he will find that I have there exclusively employed his phrase "Survival of the Fittest." The expression "Preservation of the Fittest," not used by Mr. Spencer, was inadvertently introduced in writing the abstract. This was done hurriedly between the sittings of the Amer. Assoc. Adv. Sci for a reporter of the *New York Tribune*, and was subsequently printed by the *Naturalist* while I was absent on the Plains of Kansas. It therefore contains several obscurities, the result of an attempt to abridge, and a number of typographical blunders. The essay will be found to be free from these.

There being no misrepresentation of Mr. Spencer's views on this point, I notice the second objection he makes. Where, in the sentence regarding the Survival of the Fittest, I say that "this neat expression no doubt covers the case, but it leaves the origin of the fittest entirely untouched," Mr. Spencer regards my language as an "indirect statement that I" (Mr. S.) "have done nothing to explain the origin of the fittest."

It is plain enough that my remark does not apply to Mr. Spencer or to his writings, but exclusively to the doctrine of Natural Selection, and to Mr. Spencer's terse phrase, "which no doubt covers the case," *i.e.* Natural Selection (not the whole theory of Evolution). I cannot see that this language can be tortured into the interpretration Mr. Spencer places upon it, but Mr. Spencer's language decidedly implies that my statement is literally correct.

I am, however, well aware that Mr. Spencer has done more than any living man to explain the "Origin of the Fittest," and on this account in particular his name does not appear in my criticism. Another reason for its omission is that I have taken the liberty not to read his work, "The Principles of Biology," because I have suspected, from my reading of other works of this philosopher, that it is in advance of other treatises on the subject. I postponed it until, by investigation "in the shop," I should have attained to some definite views based on reasoning uninfluenced by the opinions of others, hoping to use "The Principles of Biology" thereafter in such a way as its merits and justice to its author should require.

EDWARD D. COPE

Philadelphia, Feb. 20

Ethnology and Spiritualism

THERE is only one point in Mr. Tylor's communication (NATURE, Feb. 29, p. 343) on which it seems desirable that I should say a few words, in order that I may not be supposed to assent to what I conceive to be a most erroneous view. Mr. Tylor suggests that the phenomena that occur in the presence of what are called mediums, are or may be of the same nature as the subjective impressions of persons under the influence of a powerful mesmeriser. Five and twenty years ago I was myself

*Under the title, "The Method of Creation of Organic Types."

a practised mesmeriser, and was able to produce on my own patients almost the whole range of phenomena which are exhibited in public as illustrative of "mesmerism" or "electro-biology." I carried on numerous experiments in private, and paid especial attention to the conditions under which the phenomena occur. During the last seven years I have had repeated opportunities of examining the phenomena that occur in the presence of so-called "mediums," often under such favourable conditions as to render trick or imposture simply impossible. I believe, therefore, I may lay claim to some qualifications for comparing the mesmeric with the mediumistic phenomena with especial reference to Mr. Tylor's suggestion, and I find that there are two great characteristics that broadly distinguish the one from the other.

1. The mesmerised patient never has *doubts* of the reality of what he sees or hears. He is like a dreamer to whom the most incongruous circumstances suggest no idea of incongruity, and he never inquires if what he thinks he perceives harmonises with his actual surroundings. He has, moreover, lost his memory of what and where he was a few moments before, and can give no account, for instance, of how he has managed to get out of a lecture-room in London to which he came as a spectator half an hour before, on to an Atlantic steamer in a hurricane, or into the recesses of a tropical forest.

The assistants at the *séances* of Mr. Home or Mrs. Guppy are not in this state, as I can personally testify, and as the almost invariable *suspicion* with which the phenomena are at first regarded clearly demonstrates. They do not lose memory of the immediately preceding events; they criticise, they examine, they take notes, they suggest tests—none of which the mesmerised patient ever does.

2. The mesmeriser has the power of acting on "certain sensitive individuals" (not on "assemblies" of people, as Mr. Tylor suggests), and all experience shows that those who are thus sensitive to any one operator are but a small proportion of the population, and these almost always require previous manipulation with passive submission to the operator. The number who can be acted upon without such previous manipulation is very small, probably much less than one per cent. But there is no such limitation to the number of persons who simultaneously see the mediumistic phenomena. The visitors to Mr. Home or Mrs. Guppy all see whatever occurs of a physical nature, as the records of hundreds of sittings demonstrate.

The two classes of phenomena, therefore, differ fundamentally; and it is a most convincing proof of Mr. Tylor's very slender acquaintance with either of them, that he should even suggest their identity. The real connection between them is quite in an opposite direction. It is the mediums, not the assistants, who are "sensitives." They are almost always subject to the mesmeric influence, and they often exhibit all the characteristic phenomena of coma, trance, rigidity, and abnormal sense-power. Conversely, the most sensitive mesmeric patients are almost invariably mediums. The idea that it is necessary for me to inform "spiritualists" that I believe in the power of mesmerisers to make their patient believe what they please, and that this "information" might "bring about investigations leading to valuable results," is really amusing, considering that such investigations took place twenty years ago, and led to this important result—that almost all the most experienced mesmerists (Prof. Gregory, Dr. Elliotson, Dr. Reichenbach, and many others) became spiritualists! If Mr. Tylor's suggestion had any value, these are the very men who ought to have demonstrated the subjective nature of mediumistic phenomena; but, on the contrary, as soon as they had the opportunity of personally investigating them, they all of them saw and admitted their objective reality.

ALFRED R. WALLACE

Development of Barometic Depressions

IF I have misrepresented Mr. Ley's views, the misrepresentation was certainly unintentional; but after fairly considering his letter in NATURE of February 29, I am unable to see that I have misrepresented his views, so far as they are exposed in his "Laws of the Winds prevailing in Western Europe." Part II., of course, I ignored. It is not yet published; for aught I know, is not yet written; and as I have not the pleasure of a personal acquaintance with Mr. Ley, it is difficult to understand how I could be expected to express any opinion on a book which is still in the womb of the future. But as to the present work, Part I., which I read and reviewed, it is mainly occupied with instances, ingeniously worked out, in illustration of the rule which he distinctly enunciates, that revolving storms are due to the depression of the barometer caused by a heavy rain over a large area. Perhaps, in the same way, Part II. is to be mainly occupied by an examination and discussion of the still more numerous instances in which revolving storms have not followed heavy rain over a large area; and if so, I shall be glad in due time to give it my best attention. But for the present, having before me merely the author's existing work, I repeat what I have, in effect, already said, that the occasional or even frequent sequence of rain and storm does not establish between the two a relationship of cause and effect.

A very casual examination of our own registers, and those of Western Europe generally, would show that instances of rainfall quite as great as any that Mr. Ley adduces, happen very frequently without any storm following; and clearly if Mr. Ley's rule is sound, it must apply to all instances which cannot be claimed as exceptions, and that not only in our own latitudes, but in other parts of the world, and especially in those parts where the rainfall is excessive. It was certainly not "necessary" to travel to Khasia for instances of the failure of this rule; but its failure was exhibited in the most full and clear manner by a reference to that extraordinary rainfall.

Mr. Ley speaks of some "fact" relative to the Himalayas which "may be denied." I do not quite understand what fact he means. The facts I have spoken of are the "heavy and long-continued precipitation," and a very great depression of the barometer." If it is either of these that he wishes to deny, I can only say that his doing so confirms my former statement that he has confined his investigations too exclusively to Western Europe. But when I spoke of the one as causing the other, it was not as stating a fact, but as suggesting a probability; whilst whether there is or is not "a region in which Ballot's rules are contravened" I am unable to say; if there is I have not discovered it, and I don't know where it is, but it is not near the Himalayas, where, so far as we know, the circuit of the wind is quite in accordance with Buys Ballot's Law, though on a scale of extreme magnitude—of such magnitude indeed that our observations do not extend to the end of it. It is curious that an author who, like Mr. Ley, writes sensibly within his professed boundaries, should have limited his studies so closely as he appears to have done; but as the remark to which I have just referred shows pretty conclusively that he has not examined into the range of the barometer in India, so the remark which he makes about the advance of cyclones "in the West Indies, *e.g.*," shows that he is strangely in the dark as to the variations of temperature in the tropical Atlantic.

The columns of NATURE are not the place to discuss at length such well-worn subjects as either Buys Ballot's law or the influence of the earth's rotation, and certainly whether the earth's rotation does or does not produce the effect attributed to it, was quite beyond the scope of my former allusion to it; but I said and repeat that its influence is not "obvious," that an argument based on it is not a "truism," and that to apply these words to a point that is at any rate doubtful is both objectionable and improper.

J. K. L.

Solar Intensity

I HAVE read with interest the criticism in your last number of Padre Secchi's Solar Intensity Apparatus. With reference to the single point of the discordant results obtained by thermometers with bulbs of different size, I would observe that I encountered a similar difficulty some years ago in investigating the adaptability of the instrument invented by Herschel, commonly called the "black bulb *in vacuo*," to regular comparable meteorological observations. I found that the large bulbs always gave a higher reading than the small bulbs. I supposed this to proceed from the colder stem depriving the blackened bulb of its heat, the larger bulb, of course, losing less than the smaller, and I overcame the difficulty entirely by having about an inch of the stem as well as the bulb coated with lamp-black. I am not sure, however, that this would answer so well in a non-exhausted chamber. Probably a small bulb will always be cooled by convection more rapidly than a large one.

In the excess of the temperature indicated by the improved instruments I have referred to over the temperature of the air, at the same height—usually 4ft.—above the soil (which is also very

nearly the temperature of the outer glass in which the blackened thermometer is enclosed), we have not indeed an absolute measure of solar intensity; for all measures of that must, it would seem, depend on the substance exposed and the conditions as to cooling, &c., under which the exposure takes place, but a sensitive test by which slight variations in its amount can be determined, and the amount at different places and different times compared. F. W. STOW

The Aurora of February 4

THE following is an account of the aurora of February 4 as seen by a gentleman living in Russia, at Anspatti, in the province of Vitebsk. After stating that the barometer had risen very high (30·2), he says:—"To-night, as I drove home from Reugarten, there was the most beautiful aurora borealis I ever saw. It began in the north-west, and gradually rose higher and higher, till at last it reached the horizon a little north of east, and such a broad band, or rather succession of bands, that it covered half the heavens. It was a bright rose colour, and its light and colour were reflected by the snow, so that the whole earth was rosy; though it was between nine and ten o'clock, and there was no moon, it was nearly as light at day. It is still in full force as I am writing, and I can see it from my window, but it constantly changes its form and colour." I think the latitude of the place is 56 or 57. J. M. H.

Aurora Island

NATURE for May 25 (which has only just reached this part of the world) contains a note respecting the reported disappearance of Aurora Island in the New Hebrides. In that note the small upraised coral island of that name north-east of Tahiti is confounded with Aurora—a high volcanic island—more than 40° to the west of the former. It is scarcely to be wondered at that the mistake should be made when the name of the island is alone given; but when "Aurora Island, one of the New Hebrides group," is spoken of as being to the "north-eastward" of the well-known island of Tahiti one feels surprised at the misconception.

Has it yet been clearly defined to which Aurora the report refers, and is it not more probable that the captain's chronometer was out, or that his reckoning was incorrect, than that either island has really been submerged? A few months ago Dr. George Bennett, F.L.S., of Sydney, New South Wales, showed me a sketch which he made of Aurora in the New Hebrides some years ago. From that the island appears very mountainous, and the map of Melanesia, in Petermann's Geographische Mittheilungen (1870), makes it about twenty miles long and 2,000ft. high.

S. J. WHITMEE

Samoa, South Pacific, Nov. 4, 1871

P.S.—The following notes of earthquakes in the Samoa group may be of interest to some of your readers:—

May 14, 1871.—2.5 P.M. First a vertical, followed by a horizontal, shock.
July 1, ,, —9.30 A.M. Slight horizontal shock.
,, 16, ,, —12.10 P.M. Vertical shock.
Aug. 3, ,, —12.15 P.M. Slight horizontal shock, accompanied by a loud rumbling noise.
Sept. 23, ,, —6.45 A.M. A slight horizontal shock.

I was absent from Samoa from September 1870 to April 1871. During that time there were eight shocks of earthquake in the group; but the dates and other particulars were not noted. One is reported as having been the most severe shock known here. Earthquakes have been more frequent in Samoa for the past year or two than formerly.

FOUL AIR IN MINES AND HOW TO LIVE IN IT

I.

I BEG to forward you for publication in NATURE an account of some very interesting experiments recently made at Chatham, on the employment of a respirator in military mining. They were conducted in a thoroughly practical manner by Mr. J. Edward Gibbs, a highly intelligent young officer of Engineers, who, I may add, has given the respirator a very convenient form, and, I trust, will continue the work he has so well begun.

It is to be borne in mind that the cotton wool employed in the respirator is not to be *steeped* in glycerine, but *moistened* with this substance; the wool ought to be well teased until all its fibres are wettedb, ut they must not form a clot. JOHN TYNDALL

"When on duty at the Defensive Mines one day during the mining operations of July and August 1871, three men were brought out in a fainting state, caused by a rush of foul air in untamping. Thinking some means might be devised for preventing such accidents, and the consequent loss of time and panic, I consulted with Captain Malcolm, R.E., who proposed Prof. Tyndall's firemen's respirator for consideration. Colonel Lennox sent me to the maker to inquire, and I returned with one.

"With the assistance of Quartermaster-Sergeant Ingram of the Chemical Laboratory, and several books of reference, I have collected the following notes:—

"After exploding a charge of gunpowder at a gallery-head, it becomes dangerous to untamp, because of the poisonous gases produced by the combustion of the powder. These gases are CO_2, N, CO, HS, C_2H_4, and H. The only gases that are present in sufficient quantities to harm are CO_2 and CO. CO_2 to the amount of $\frac{1}{200}$ (·005) of the bulk of the air at the gallery-head would render it unfit to sustain life. CO to the amount of $\frac{1}{100}$ (·01) would do the same. 100 lbs. of powder evolve 22559·38 cubic in. of gas at 60° F. and 30″ B., of which 9429·7896 are CO_2, and 2249·848 are CO.

"Miners working in the presence of the foul air from the explosion suffer in two ways. If affected suddenly, they feel a burning at the nape of the neck, and their limbs tremble, they turn giddy and faint. This is to be attributed chiefly to the CO. The miners are also affected in a slower manner by the CO_2. They feel their breathing becoming difficult, as if there were a weight on their chest, with a tight feeling in the head; if not brought into the fresh air they are in time overcome and faint. This also brings on headache, on coming into fresh air.

"Any method of getting rid of the foul gases by chemical means must interfere greatly with the progress of the work. In any case there would be considerable difficulty in destroying the CO, as it has neither acid nor basic properties. A *good* system of ventilation through hose would clear the galleries of the foul air, but would not overcome the difficulty of untamping, because at any moment of the process there may be a rush of foul gas, which would take effect on the men at work, before the ventilation could carry it away.

"A good respirator worn by each of the men employed at untamping might overcome this difficulty. Prof. Tyndall's respirator for firemen is constructed with a view to enable the men to inhale pure air when at work in a burning house, by separating the smoke and noxious vapours. It consists of two parts; (1) the mouth-piece; (2) the body of the respirator.

"The mouth-piece is an invention of a Mr. Carrick, hotel-keeper at Glasgow, who had patented it.* It has two valves, *i* and *e*. (See NATURE, June 15, 1871.) The air inhaled comes from below, up through the body of the respirator and through *i*. The exhaled breath closes *i*, and escapes through *e*, thus keeping the contents of the body of the respirator cool. There is an aperture *o*, which fits closely round the lips, and to prevent respiration through the nose, there is a nose-pad fixed on top of the mouth-piece. A wire-gauze partition separates the mouth-piece from the contents of the body of the respirator.

* This is not the mouth-piece now adopted.—J.T.

"The body of the respirator is about 4in. or 5in. long, and contains at the top a layer of cotton wool, moistened with glycerine to prevent any solid particles escaping into the mouth from lower layers, and also to stop those very minute particles of the smoke that may not have been arrested below. Next comes a layer of dry cotton wool, then a layer of charcoal fragments, another layer of dry cotton wool, and then some fragments of slaked lime. Below this comes some more cotton wool, and then the wire-gauze cover or cap at the bottom.*

"For smoke the layer of lime is not necessary, but in the mines it would be of the greatest use, because it has a great attraction for CO_2. The layer of charcoal would absorb the CO and the HS in the air, and the mixture inhaled would be perfectly innocuous. The disadvantages of this respirator in its present form for mining purposes are—that it is too long, and an effort is required in breathing through the small valves.† Mr. Ladd, of Beak Street, Regent Street, the maker of these respirators, has made some improvements in the mouth-piece, which may overcome some of the inconveniences of the old pattern.

"I received permission to use the R.E. workshops for experimenting on the shape best suited for use in the mines. Tyndall's respirator has been severely tested in dense and pungent smoke from pinewood, and it succeeded to the perfect satisfaction of Captain Shaw, Chief Officer of the London Fire Brigade. Firemen are to wear it attached to hide helmets, but for the mines any arrangement which will support the respirator and keep it close to the mouth during work, without being hot or uncomfortable, will suffice.

"*Experiments made with the Respirator.*—On Saturday, August 19, 1871, a trial of the respirator was made in the Chemical Laboratory, S.M.E., in the presence of Colonel Lennox, Dr. Fox, and others. I was shut up in an air-tight cupboard, with the respirator on. By my side were jars containing CO and CO_2 in a proportion of $\frac{1}{200}$ each of the cubic content of the cupboard (141,698·4 cubic in.), not allowing for the space occupied by my own body and the stool on which I sat. The respirator contained animal charcoal and lumps of slaked lime mixed together, thus dispensing with one layer of cotton wool. After emptying all the jars, I remained for ten minutes in the full mixture (fifteen minutes in all) without the slightest discomfort except from the awkward shape of the respirator. I was then called out.

"On Monday, the 21st, another trial was made in the presence of Dr. Fox and Lieuts. Abney and Galwey. This time a rabbit and three birds were placed in the cupboard with me. The respirator contained, in addition to the charcoal and slaked lime, a small quantity of sulphate of soda. The only cotton wool used was a small layer soaked‡ in glycerine at the top, and a thin layer of dry wool at the bottom. The sulphate of soda was introduced according to Prof. Graham's advice, in order to give an atom of O to the CO to form CO_2, becoming itself sulphite of soda. The content of the cupboard is 141,698·4 cubic in.: from this would have to be deducted the space taken up by my body, say $3\frac{1}{2}$ cubic ft. (Dr. Parke's Hygiene), or, roughly, 6,000 cubic in., leaving 135,698 cubic in. 1,890 cubic in. of CO_2 in jars were introduced from a pressure bag, making altogether:—

1,890 cubic in. of CO_2
1,921 cubic in. of CO,

or 3,811 cubic in. of poisonous gases in addition to my exhaled breath, or about 3 per cent. of the capacity of the cupboard. In order to perfect the mixture of the gases, I waved a towel about constantly, and after the end of the trial, a taper being extinguished at the top of the cupboard showed that the CO_2 had been stirred up to the top. The rabbit and two birds died at the same time, about twenty-three minutes after the cupboard was closed, while the CO from the pressure bag was being introduced. I stayed in the cupboard thirty minutes (five minutes after the mixture was completed and seven minutes after the death of the animals). When I came out I felt a pressure on my ears, as when descending too rapidly in diving. Dr. Fox said that this was produced by my blood, my heart then beating at a high rate.

"This is satisfactory, as showing that the gases had not affected me, but only the exertion of breathing through the respirator, for thirty minutes, combined with the heat of the close atmosphere in which I was.

"To prove that the gases did not affect me, I quote some extracts from Dr. Park's 'Hygiene':—'Dr. Angus Smith says the breathing of CO_2 to the extent of 1·5 to 2 per cent. produces slowness of heart action, while the respirations become quickened if not gasping; this is perceptible with as little as ·1 per cent. Less than $\frac{1}{2}$ per cent. of CO has produced poisonous symptoms, and more than 1 per cent. is rapidly fatal to animals. CO in excess produces loss of consciousness, slowness of heart action, and finally paralysis of the heart.

"The slowness of diffusion of the two gases was remarkably shown by the effect on the third bird. The cage which held it was suspended at the top of the cupboard. The bottom, back, and top were of wood, the other sides were of wood for about $1\frac{1}{2}$ in. and then of wire. The bird, which was at first on a perch, was very soon affected by the impure air, and fell to the bottom of the cage. Here the wooden bottom and sides evidently supported a layer of pure air, for although the bird had lost consciousness, and indeed was considered to be dead, yet after being brought out into fresh air, it was revived by ammonia, and after an hour or so fluttered away. The other animals, that were not so protected, died before all the gases had been introduced.

"On examining the sulphate of soda, very little was found to have been changed into the sulphite; it would, therefore, seem that a constant change occurred, the sulphate giving up oxygen to the CO, becoming sulphite, and then the sulphite taking oxygen from the air to form the sulphate. Whether the good effect of the first change compensates for the loss of free oxygen in the second change is a question for the opinion of a chemist; however, Prof. Graham's recommendation is of great weight.

"All that were present agreed that the trial was perfectly satisfactory, and I think this is a fair conclusion. For the object in view throughout has been to devise some plan by which a man may work for some time in a foul mine, and may be secure from the effects of a rush of foul gas caused in untamping, &c.

"Defensive mines, though small, poison the ground more effectively than overcharged mines, which allow most of the gas to escape. I have before shown the total amount of CO and CO_2 evolved by the explosion of 100 lbs. of powder, which, according to our late operations, seems to be an average charge. It is probable that a large proportion of these gases would escape into the air, and that the rest would be diffused equally all round the charge. Therefore only a small amount is likely to be encountered at any one point. Hence it would seem that the respirator, which has succeeded with very powerful mixtures of poisoned air, would be quite enough to guard the miners from any of the gases from explosions.

"It only remains now to hit upon a convenient shape which will not render the breathing laborious. If we succeed in this, it is likely that the respirator would be of use also in civil work, such as exploring mines in search of bodies after a colliery accident."*

J. E. G.

* This order may be varied in different ways without prejudice to the respirator.

† These objections have been in great part met by the recent forms of the respirator.

‡ See remark in the introduction above.

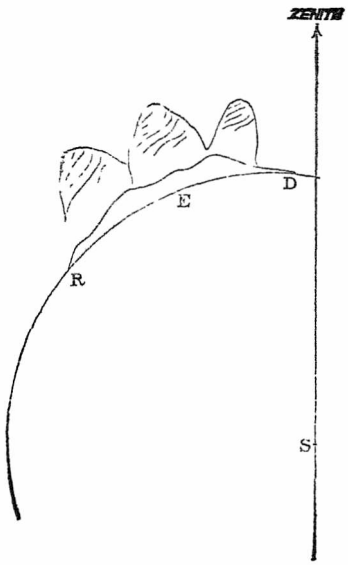
* This is one of the purposes contemplated by myself, but the suggestion of Mr. Gibbs is independent and original.—J. T.

THE STRUCTURE OF THE CORONA

AMONG the parties organised to observe the Total Eclipse of 1869, Aug. 7, that sent from the Cincinnati Observatory was probably favoured above all others in the advantage of having a comparatively elevated station and an exquisite atmosphere. The publication of the work done by this party has been delayed by the fact that for a year subsequent to the eclipse I was wholly absorbed in the labour attending the maintenance of the "Weather Bulletin of the Cincinnati Observatory," and my subsequent occupations in the present office have entirely prevented me thus far from even attempting the reduction of our observations: the original note-books are at present packed away with the library of the Observatory, awaiting the removal and rebuilding of that institution.

My own attention was expressly given to the structure of the corona and coronal streamers, for which purpose I used the full aperture of an exquisite six-inch objective (one that had received a prize at the Paris Exposition Universelle), and which was loaned to the Eclipse Expedition by Mr. T. G. Taylor, of Philadelphia.

A short notice of the principal features noted by myself was sent at once to the editor of the *Astronomische*



Nachrichten, but has not yet been published, and I therefore take the liberty of restating through your wide-spread journal the simple phenomena that I then saw.

Our station was at Sioux Falls City (formerly Fort Dakotah), in the south-eastern corner of Dakotah Territory, latitude 44°, longitude 97°, elevation about 1,500 feet above sea-level, in the midst of an extended plateau. Rain and cloud had continued up to a few hours previous to the critical moment, but the atmosphere during the eclipse was of surpassing steadiness and clearness.

The altitude of the sun at time of totality was about 40°, the local time 3.30 P.M., the duration of totality 4 minutes. No sooner had totality begun than, after sketching in most of the prominences as points of reference, I viewed the corona without darkening glasses, and with a magnifying power of probably 120 diameters. The whole interval of totality was, unfortunately, not at my disposal, owing partly to the very rough and faulty stand supporting the telescope (everything had to be transported 100 miles by mules into a wilderness), and partly to an interruption by one of the members of the party; but there seemed to me to be no doubt of the facts as recorded, nor was I conscious of the least undue emotion that might have interfered with my reliability as a witness, although it was the first total eclipse that I have had the pleasure of observing.

As seen through my inverting telescope, the structure of the large protuberance on the right hand lower limb was well made out. The neighbourhood of the sun was examined to a distance of its own diameter (a radius of possibly one degree from the sun's centre), but no trace of the coronal rays as they were seen by others of my party. The evidence as to the existence, shape, and positions of these streamers, as given by my six assistants, was conclusive as to their actual appearance, with the usual variations as to details.

That they were not detected by the six-inch glass was probably due to their diffused light and the small field of view. On the apparent upper and left hand limb of the sun, the six-inch glass showed the long series of red prominences depicted in the photographs published by the Naval Observatory. Above the greater portion of the arc of the sun's limb thus covered, and extending somewhat farther to the right, appeared to rise up three and possibly more conical masses of pearly light.

These were distinctly contrasted against the light diffused as the background of the field of view, and there was every evidence that they had an identical structure and cause. The outline of each of the pearly mountains was that of a rounded cone, as shown in the drawing—exactly resembling the kilns used in some branches of pottery and other manufactures. The apices of the cones were blunted or truncated, and not well defined; the outlines of the sides of the cones were quite sharp down to within a few minutes of the sun's limb, when all three appeared to begin to lose their distinctive characteristics.

The height of the apices above the limb varied between one-half and two-thirds of the solar radius; the diameters of the bases of the cones were probably included between seven and three minutes. Each apex was of a slightly dusky shade compared with the body of the cone.

The most interesting feature was an unmistakable striation upon the surface of each cone; the striæ apparently twisting spirally around up to the apex opposite to the movement of the hands of a watch, as represented in the accompanying drawing.

I noticed no colouration of these striæ other than their darker hue. The details of this striking and new phenomenon interested me so much that I naturally enough lost the observation of the third contact. The pearly cones were on that limb of the sun from which the moon was moving, and the details were every moment becoming more distinct, when the growing height of the bank of red protuberances was followed by the too speedy apparition of the glowing sun beneath.

Chagrin at the loss or imperfect observation of the third contact caused me to forget to note whether the three cones continued in view for any number of seconds thereafter. From the time of first recognising the pearly cones, until their disappearance, probably thirty seconds elapsed (I am writing without my note-book or other aid to memory), and I did not note any change in the appearance of the striæ.

The middle one of these cones caught my eye more especially, and the impression was that the other two, especially that on the right, was some distance behind it, or possibly obscured by a cloud of haze in the solar atmosphere. At the time it seemed to me that I saw in the central cone a column of smoke and hot gas ascending high above the area of red flames, then visible on the surface of the sun, and that the other two cones corresponded to other areas of red flames behind. The difference in character and position between these cones and the coronal streamers as observed by the others with the naked eye, and with opera glasses, seemed to argue that the latter were very probably individual subjective phenomena, or that they originated in the earth's atmosphere

whilst the pearly cones existed in the solar atmosphere and constituted a true solar corona.

My long delay in making this communication to the scientific world will be excused, I trust, in view of the imperative demands made upon my time during the two years that have elapsed since the Eclipse of 1869. I shall be deeply interested to learn whether the phenomena seen by myself may not be repeated on some other occasion and be studied by more experienced observers.

I may add that I had hastily provided myself with a Nicol's prism in hopes of making at least some trial of the nature of the coronal light; but the rude apparatus did not work satisfactorily, and I confined myself to details of structure; indeed, in my earnest gaze upon the novel phenomena I quite forgot the polarising apparatus.

CLEVELAND ABBE

Office of the Chief Signal Officer, U.S. Army,
Washington, Feb. 6, 1872

EARTH-CURRENTS AND THE AURORA BOREALIS OF FEBRUARY 4, 1872

IT is unfortunate that more accurate observations of the electrical phenomena accompanying auroral displays cannot be made upon the telegraph wires of this country. The truth is, public business cannot be made to suffer for scientific investigation, and at such moments the disturbance of the wires makes it more than ever imperative that delays should not occur. The whole efforts of the staff are directed to maintain the communications intact, hence the observations made on February 4 are not very numerous, though they are sufficiently interesting to deserve record.

At Portsmouth twenty-six observations were made of the direction and strength of the earth-currents on a wire extending from Portsmouth to London, *viâ* the London and South-Western Railway—a length of 74 miles, giving a resistance of 995 ohms. These were as follows:—

Time.	Direction of	Strength.	Remarks.	Time.	Direction of Current	Strength.	Remarks.
5.54	P	30°	The observations were made upon an ordinary vertical galvanometer, and 40° was equal to about 20 Daniell's cells.	6.41	P	40°	No observations made between 6.41 & 7.35.
6. 8	,,	20		—	—	—	
6.11	,,	10		7.35	—	0	
6.13	,,	30		7.42	N	41	
6.15	,,	25		7.56	,,	68	
6.17	,,	40		8.6	—	0	
6.19	,,	30		8.8	—	0	
6.21	N	15		8.15	N	35	
6.23	,,	24		8.22	P	12	
6.25	P	20		8.28	—	0	No observations made between 8.30 & 9.0 P.M.
6.27	,,	20		8.30	—	0	
6.29	—	0		—	—	—	
6.31	P	8		9 0	—	0	
6.33	,,	13		9.40	—	0	

P means Positive from London to Portsmouth.

The officer who made these observations writes:—"Strong deflections arising from earth currents were observed on all circuits except the local ones. The duration of the currents changed from north to south at intervals of a few minutes, and varied in strength from 1° to 68°. The strength of the current was proportionate to the length of the wire. Thus Chichester circuit (a short one) was affected less than the Guildford, and the latter less than the London circuits. The working was maintained to London with comparative ease by looping two circuits together at each end." The latter method is that usually adopted to overcome the disturbance due to earth currents, but of course it is only applicable in places where there are two wires or more.

Another officer at the Waterloo Station, London, observed the deflections gradually appear on every needle circuit, of which many concentrate at that station. They commenced about 2 P.M., and from that period to 8 P.M. they had all alike been more or less disturbed. It was noticed that the needles moved over gradually, not by a continuous motion, but by jerks, resembling that of the minute hand of a large clock. This has, however, been proved to be due to the friction of the pivots, and not to any pulsations in the currents.

The currents were always most apparent, and first noticeable on the longest lines, and as the lengths of the circuits terminating at Waterloo are very variable, this gradual appearance was very interesting. Lines running south-west and west appear to have been most affected.

All the wires in the Channel Islands were also very much disturbed. In fact Jersey was broken down to England for three hours, owing to the fact of there only being one cable. The section most affected was that between England and Guernsey. It was also noted that the wires in France were very much influenced.

The records from abroad show that, as in previous cases of storms of this character, the effect has been simultaneous all over the globe. The French Atlantic cable was seriously affected; the strength of the current was at one time equal to 90 Daniell cells. It was at times impossible to read even with condensers in circuit. The American lines were also disturbed in the East, West, and North, but not in the South.

It is much to be regretted that simultaneous observations cannot be made in various parts of the globe, detailing, in comprehensible units of measurement, the direction and strength of these currents, as well as the exact time of their appearance and disappearance. We might then arrive at some knowledge of their cause.

Southampton, Feb. 24 W. H. PREECE

THE DARMSTADT POLYTECHNIC SCHOOL

THE following epitome of the programme of the "Grand Ducal Hessian Polytechnic School of Darmstadt" may interest the readers of NATURE as a further illustration of the facilities offered in Germany for technical training of the highest and most practical kind.

The object of the school is stated to be a thorough scientific, as well as artistic, education, for all technical pursuits, assisted by appropriate practical exercises. The institution affords special facilities for the education of architects, engineers, mechanical and chemical technicists, manufacturers, craftsmen, and agriculturists. The institution is divided into the following sections:—(1) the Lower School; (2) the School of Architecture; (3) of Engineering; (4) of Machinery; (5) of Technical Chemistry; and (6) of Agriculture.

The Lower School aims at giving a general instruction in mathematics, natural science, and design, as a foundation for the special pursuits taken up afterwards. For admission into the school it is necessary that the student shall be sixteen years of age, and have received such an education as would be afforded by the highest class of a "Realschule," or the third course of a "Gymnasium," with the exception of the dead languages. This implies a knowledge of algebra, as far as equations of the second order, an acquaintance with logarithms, with plain geometry, and the elements of solid geometry, practice in German style, a knowledge of the outlines of history, and some practice in linear and free-hand drawing.

Examinations are held in the lower school at the end of each half-year, in the other divisions at the end of each year; a diploma is only given if the student gives satisfactory evidence of having completely mastered one of the branches of technical study in which special instruc-

tion is given. The payments consist of an entrance-fee of 5 fl., and a payment of 50 fl. per annum ; and in addition 6 fl. is charged for every day's work of 7 hours in the chemical laboratory ; 10 fl. for 2 afternoons of 3 hours in the physical laboratory.

In addition to the subjects required in each special department, lectures or instruction are given in the following subjects, and attendance at some of them is strongly recommended to all students, in order to give a wider culture than would be attained by exclusive attention to his special pursuit :—(1) Exercises in Literature and History ; (2) the French and English Languages ; (3) the General History of Art ; (4) National Economy ; (5) Commercial Knowledge ; (6) the Principles of Jurisprudence; (7) Physical Geography; (8) Zoology; (9) Systematic Botany ; (10) Singing and Gymnastics.

The course in the Lower School extends over two years, in which the following subjects are compulsory :—First year. (1) History and Literature with the German Languages ; (2) Higher Algebra ; (3) Stereometry and Trigonometry ; (4) French ; (5) Outline Geometry; (6) Free-hand Drawing. Second year. (1) History and Literature with the German Language ; (2) Analytical Plane Geometry ; (3) Algebraic Analysis, the Differential and Integral Calculus ; (4) Higher Algebra ; (5) Experimental Physics; (6) Mechanics; (7) French; (8) Free-hand Drawing ; (9) Outline Geometry.

In the special schools for Architecture, Engineering, Mechanics, Technical Chemistry, and Agriculture, the entire course extends over a period of from two to four years. The extent to which the studies are carried will be illustrated by the following abstracts of the curriculum in the Agricultural School, the shortest of the courses :—First year (1) Experimental Physics; (2) Experimental Chemistry ; (3) Chemical Exercises ; (4) Histology and Morphology ; (5) Vegetable Physiology ; (6) Systematic Botany (with excursions) ; (7) Zoology ; (8) Mineralogy ; (9) The Study of Rocks ; (10) Anatomy of Domestic Mammalia ; (11) Physiology of Domestic Mammalia ; (12) External form of Domestic Mammalia ; (13) Agricultural Implements and Machines ; (14) National Economy ; (15) Mathematics ; (16) The Drawing of Plans. Second year—(1) Chemical Exercises ; (2) Agricultural Chemistry ; (3) Practical Microscopy ; (4) Practical Physiology ; (5) The Diseases of Plants ; (6) General Agriculture ; (7) Special Agriculture ; (8) General Breeding of Animals ; (9) Special Breeding of Animals ; (10) The Commerce of Agriculture ; (11) The Cultivation of Garden, Orchard, and Vine ; (12) Internal Diseases of Domestic Mammalia ; (13) External Diseases of Domestic Mammalia ; (14) Technology (Heating and Lighting) ; (15) Agricultural Book-keeping ; (16) Irrigation, Tilling, &c. ; (17) History and Literature of Agriculture ; (18) Practical Geometry.

To assist in the studies of the pupils there are chemical and physical laboratories, an experimental farm, mineralogical, zoological, and botanical collections, models of machinery, designs, libraries, excursions into the country, &c. Under special circumstances students can be admitted as "Hospitanten" to certain only of the studies, without going through the entire course ; but care is taken that this does not interfere with the regular studies of the other students.

LAKE VILLAGES IN SWITZERLAND

IT is satisfactory to find that the correspondents of some of the daily journals are now in the habit of giving scientific information to their readers. The following is taken from the *Standard* :—

"An interesting archæological discovery has recently been made on the shores of the Lake of Bienne. The Swiss Government has been for a long time endeavouring to drain a considerable tract of land between the two lakes of Morat and Bienne, but in order to do this effectually it has been found necessary to lower the level of the latter by cutting a canal from it to the lake of Neuchatel. At the beginning of the present year the sluices were opened, and the waters of the Lake of Bienne allowed to flow into that of Neuchatel. Up to the present time the level of the Bieler See has fallen upwards of three feet, and this fall has brought to light a number of stakes driven firmly into the bed of the lake. This fact becoming known, a number of Swiss archæologists visited the spot, and it was decided to remove the soil round these stakes to see whether any remains of a Lacustrine village, which they suspected had been raised upon them, could be traced. At a distance of between five and six feet from the present bed of the lake the workmen came upon a large number of objects of various kinds, which have been collected and are at present under the custody of Dr. Gross, of Locrass. Among them are pieces of cord made from hemp, vases, stags' horns, stone hatchets, and utensils used apparently for cooking. The most precious specimen is, however, a hatchet made of néphrite (the name given to a peculiarly hard kind of stone from which the Lacustrines formed their cutting instruments). This hatchet is sixteen centimetres long by seven broad, and is by far the largest yet discovered in any part of Switzerland, no other collection having any measuring more than eight centimetres in length. A quantity of the bones found at the same time have been sent to Dr. Uhlmann, of Münchenbuchsee, for examination by him, and he finds that they belong to the following animals, viz. :—stag, horse, ox, wild boar, pig, goat, beaver, dog, mouse, &c., together with a number of human bones. If the level of the lake continues to sink, it is hoped that further discoveries will be made, and the scientific world here is waiting the result of the engineering operations with keen interest."

NOTES

WE have great pleasure in announcing that Prof. Andrew C. Ramsay, F.R.S., has been appointed Director-General of the Geological Survey in the room of the late Sir Roderick I. Murchison.

AT the moment of going to press we have received the announcement of the death of Prof. Goldstücker, the eminent Sanscrit scholar. He died on Wednesday morning.

MR. G. B. AIRY, the Astronomer Royal, and Prof. Agassiz, were elected foreign associates of the *Académie des Sciences* at Paris in the room of the late Sir J. Herschel and Sir R. I. Murchison at the meeting on the 26th ult.

DR. MAXWELL SIMPSON, F.R.S., has been elected as successor to the late Dr. Blyth in the chair of Chemistry, Queen's College, Cork. Dr. Simpson is well known to men of science at home and abroad as an accomplished chemist, and one who has been especially distinguished for his original researches.

THE Crystal Palace Company's School of Art, Science, and Literature is about to take an important step, having for its object the emphasising of the science branch of the school, in order that eventually the south of London may be provided with an institution which, in a measure, may represent the Royal and London Institutions which already exist in the west and centre. The step consists in adding to the courses of lectures on scientific subjects already given special courses to be given from time to time by scientific men of eminence, similar to the courses given in the Institutions before referred to ; and it is hoped that the same lectures and the same standard of excellence and illustration may be secured. As the lecture theatre of the school has been burnt down, the lectures, pending its rebuilding, are to be given in the theatre in the Crystal Palace ; but it need scarcely be stated that these lectures have no connection with the Crystal Palace, except so far as the School of Art, Science, and Literature is connected with it, and that they will be given at a time when the

Palace is closed to the general public. Mr. Norman Lockyer has consented to give the first course of lectures. This step taken by the Committee is in every way to be commended, and we look with confidence to the success of these lectures as paving the way for others in various parts of the country, which may eventually do much towards popularising Science among the masses.

PROF. P. MARTIN DUNCAN, F.R.S., is now delivering the course of Lectures on Biology to the class for the Higher Education of Women at South Kensington, in the place of Prof. Huxley, who is still in Egypt for the complete restoration of his health.

MR. W. MARSHALL WATTS, D.Sc., of the London University, has been appointed to an assistant mastership in Giggleswick Grammar School, Yorkshire. The governors have settled that chemistry, including practical work in a laboratory, and physics, shall hereafter be taught in the school, and the teaching of these branches of science has been entrusted to Dr. Watts. Until recently Dr. Watts has had the main charge of the teaching of chemistry in the Manchester Grammar School, a school which has been eminently successful in obtaining scholarships in physical science at Oxford. Mr. E. K. Purnell, Scholar and Prizeman of Magdalen College, Cambridge, has also lately been appointed to a classical mastership in Giggleswick School.

THE Council of the St. Andrews Medical Graduates' Association are about to appeal to the many friends of the late Professor of Medicine in the University of St. Andrews, to aid them in an attempt to make a more fitting provision for his widow than Dr. Day's ill-health allowed him to accomplish. We regret to learn that such an appeal is necessary, and heartily wish it success.

THE Haberdashers' Company have recently awarded Mr. Webb, the Senior Wrangler of Cambridge, 50*l.* for three consecutive years; he having been a pupil of the Rev. C. M. Roberts at Monmouth, of which school the Haberdashers' Company are governors. They also propose to grant four exhibitions of 50*l.* to the children or grandchildren or apprentices of Liverymen of the Company under certain restrictions, to be tenable for three years. In addition to the above, one exhibition of 50*l.* will be specially granted to a scholar of any school under the Company's management. The sum of 150*l.* will also be appropriated towards assisting the education of children of the Livery of the Company. 100*l.* yearly will also be awarded as a prize to the inventors of anything new in haberdashery.

AS the period of the Transit of Venus in 1874 approaches, astronomers both at home and abroad are becoming more and more active in their preparations; and the American committee on this subject, it is understood, has already decided in considerable part upon the stations to be occupied. Of the result of their conclusions we hope to give an account before long to our readers. In Russia the committee, under Prof. Struve, proposes the establishment of a chain of observers, at positions 100 miles apart, along the region comprised between Kamschatka and the Black Sea. The German committee has decided on recommending the organisation of four stations for heliometric observations of the planet during its transit, one of them in Japan or China, and the others probably at Mauritius, Kerguelen, and Auckland islands; and three of these, with the addition of a fourth station in Persia, between Mascate and Teheran, will be equipped for photographic observations also. The French, before the war, suggested that stations be established at St. Paul Island, New Amsterdam, Yokohama, Tahiti, Noumea, Mascate, and Suez. How far this programme will be carried out under the changed circumstances of that country remains to be seen

WE have received a letter from a valued correspondent, calling attention to some defects in the arrangements for the study of the Natural Sciences, and especially of Botany, at the University of Cambridge. The letter we refrain from publishing, in the belief that the good work which is now proceeding at the Universities will be carried out eventually far more completely than it is at present, and that even Botany may ultimately receive the attention that it deserves.

THE Brazilian steamer to New York brings advices of the safe arrival at Pernambuco of the steamer *Hassler*, with Prof. Agassiz and party. They were to leave for Rio Janeiro, in company with the *Ticonderaga*, on Jan. 16. As there are several gentlemen on board who have undertaken to supply information in regard to the movements of the vessel, we shall doubtless before long have full accounts of the progress made up to the date mentioned; although in regard to the subject of deep-sea soundings and supposed discoveries connected therewith we must probably wait, for correct details, for the official report to be made by Count Pourtales direct to the Superintendent of the Coast Survey.

THE "Annual Report of the Secretary of the Interior for the United States on the Operations of the Department for the year ending October 31, 1871," states that the results of Prof. Hayden's expedition, in accordance with his instructions to investigate the geology and natural resources of the little known, but interesting, region about the source of the Yellowstone and Missouri rivers, shows it to have been a complete success, and fully to justify the liberal provision made by Congress for it. A preliminary report of the results was to be presented to Congress at an early date. A great amount of valuable notes and specimens, illustrating the agricultural, mineral, zoological, and botanical wealth of the West, was secured.

WE learn that the Smithsonian Institution has recently succeeded in obtaining two complete skeletons of the remarkable tapir of the highlands of the United States of Colombia, known to naturalists as *Tapirus pinchaque* or *roulini*. Previously only the skull had been obtained by Roulin, by whom it was first made known, and it was one of the rarities of the great anatomical collection at Paris. The Smithsonian Institution had before obtained a number of skulls and a skeleton of the still more remarkable tapir of Panama, which had remained undistinguished from the common species of Panama till within a few years, when first described, under the name of *Elasmognathus bairdii*, by Prof. Gill, from two skulls in the Smithsonian collection. There are no external or dental differences between the tapirs corresponding with the marked differences in the skulls; the external differences being confined to the contour of the forehead, the colour, and the character of the hair. In the mountain tapir, as might be expected in an animal dwelling in such elevated regions, the hair is long and coarse, and is of a black colour, strongly contrasting with that of the common tapir of South America; it is also somewhat smaller than that species, and has the forehead less arched from the occiput. It is confined to the highlands, and is separated, at least so far as is known, by quite a wide band of country from the common species.

THE Report of the officers of the Peabody Academy of Sciences of Salem, lately made to the trustees, presents a satisfactory statement of the progress made during the past year. This establishment received a moderate endowment from George Peabody, of London, and the income is expended in the care of the valuable museum belonging to the Academy. The directors of the establishment are Mr. F. W. Putnam and Dr. Packard. The principal additions to the museum of the Academy during the year have consisted mainly of insects and archæological specimens, and also a series of the animals inhabiting the Mammoth Cave of Kentucky. All of these, together with the collections previously in the museum, have been properly arranged and classified, and tend to render the museum very attractive. The report urges very strongly the propriety of securing an additional endowment, to enable the Academy to publish in its

memoirs certain valuable scientific manuscripts now in hand, the alternative of being obliged to send them to some other establishment having more means at its disposal being greatly deplored, as they were based upon the collections of the Academy, and should legitimately appear under its auspices.

THE Clifton College Scientific Society has just issued the second part of its Transactions, containing the record of its proceedings from February to July, 1871. The president and secretary state in their Report that the papers read at the Society's meetings have been as numerous as previously, and the attendance of members and visitors has in no degree fallen off; and that, although there is still much to be desired in this respect, yet the number of working members is steadily increasing. The various sections of botany, zoology, entomology, geology, archæology, chemistry, and physics have, on the whole, done good work, the least satisfactory reports being in the case of zoology, chemistry, and physics. The great event of the half-year has been the long-expected opening of the new Museum and Botanic Garden, both of which institutions are well deserving of support from those outside the school who are able to assist in furnishing them. The Botanic Garden is already one of the very best to be met with anywhere in the provinces. Among the papers read before the society and printed in the Transactions, the following have struck us as especially excellent:—"A Scientific Visit to Cheddar," by the President and J. Stone; "The Church of St. Mary Redcliffe, Bristol," by R. W. Wilson; "The Coalfield of South Wales," by A. Cruttwell; "The Birds of Clifton," by D. Pearce; and an admirable paper on "The Spectrum," by W. A. Smith.

THE last number of the *Bulletin de la Société de Géographie* contains an article by Delesse on the oscillations of the coasts of France.

THE Annual Address, delivered before the Albany Institute, New York, by Orlando Meads, on May 25, 1871, has just reached us. It is chiefly occupied with a sketch of the history of this successful and enterprising institution.

THE *Poona Observer* of February 6 gives the following account of Indian Geological Excursions:—"The Principal of the Poona Civil Engineering College, Mr. T. Cooke, together with the Professor of Chemistry, Mr. S. Cooke, with about twenty students of the first class, proceeded on a geological excursion on January 29, and arrived here on Saturday morning last. After leaving Poona they arrived at Shabad, where they remained for a whole day. The next morning they left Shabad and arrived at Krishtna at about ten in the morning, and inspected the Krishtna Bridge. After inspecting several works of the G. I. P. R., they started for Poona on the afternoon of Friday. The thanks of the students as well as of the Principals are due to the G. I. P. R. Company, in kindly placing their waiting-rooms at the several stations where they halted, at the disposal of the boys. The expense of this excursion is to be borne solely by Government. The amount allotted for the purpose of this excursion was 500 Rs."

THE following account of the Aurora of February 4 appears in the *Times of India* of the following day:—"A magnificent Aurora was visible, from the Rawul Pindee portion of the Punjaub, last night, February 4, from 12 to past 12.30 o'clock. It occupied the northern quadrant of a clear sky, or rather more, the stars shining dimly through a glowing deep red hazy light reaching half way up the heavens, and which was crossed by thin vertical rays of white light stretching to the south. The night was calm but less frosty than usual at this season, and the oldest inhabitant who witnessed the display averred he had never seen anything like it in his life before." The suggestion made by our correspondent Mr. Earwaker, that we witnessed on that day a combination of the Northern and Southern Aurora, is thus confirmed.

SCIENCE IN PLAIN ENGLISH

IN a paper under this heading, in the *Boston Journal of Chemistry*, Mr. C. A. Joy, after quoting from our articles of June 22 and 29, 1871, proceeds thus:—We must admit that what Mr. Rushton says of English schools applies equally well to our own. Does anybody know of a preparatory school in the United States where instruction in science is given on a systematic plan by teachers especially fitted for the work, and with well-selected apparatus and judicious text-books, and where an equal value for excellence in science is given to pupils as for mathematics and the languages? There are, doubtless, some such schools, but it is my misfortune never to have heard of them. The truth is, there are few teachers. The custom in this world of studying everything else but the world we live in, which has been handed down to us from our ancestors, has precluded the possibility of anybody being fitted to teach the natural sciences excepting the few who have had the energy and the means to overcome every obstacle, and to learn something; and they are so rare that they are not to be had for ordinary schools. We are now in a fair way to acquire considerable knowledge of the planet Mars, its climate and physical condition; and it may be that we shall some day be favoured by a visit from an inhabitant of that distant world. The arrival of such a visitor would be rapidly heralded over the land, and he would be introduced to our best society, to the leading men of education; and as he would doubtless be possessed of an inquiring turn of mind, he would have many embarrassing questions to ask. He might address the inquiry to the gentleman on his right at the public dinner, which would be sure to be given to him, as to the composition of the crust of the earth; or he might ask what the glass windows were made of, and what form of light shone through them, or the water on the table and the air of the room might absorb his attention. If the respondent happened to be a University bred man the chances are ten to one he could not answer a single question; he would be forced to say that the study of the language of a people formerly occupying a small portion of the globe had monopolised all of his time, and prevented the acquisition of a knowledge of any of the natural phenomena around him; he might, in fact, have more knowledge of Mars than of the earth. It is probable that our visitor would be slightly astonished at the ignorance of the best educated members of the community. I do not know that we are bound to prepare ourselves for the approaching visit, but the very suggestion of it ought to startle us a little out of our propriety, and make us review the course of instruction we have pursued for so many years. As long as the requirements for admission to college are left just as they are at present, all persons who expect to go to college must follow a prescribed course or be found wanting. The teacher in a preparatory school knows that the pupil can attend only a certain number of hours, and to get up his task for admission to college nearly all this time must be devoted to classical studies. There is no time left for science, and it is not taught. This state of things has led to a violent controversy on the part of the advocates of the two systems, and the question appears to be no nearer a solution at the present time than it was many years ago. The advocates of classical training will not yield an inch of ground, and the scientists are equally firm. It is a pity that some compromise cannot be affected, as a knowledge of Latin and Greek is of great value to the scientific student, and ought not to be omitted. And as the classicists now have the colleges in their power, would it not be well for them to recommend a knowledge of language rather than of grammar, and a facility of reading generally instead of prescribing the precise number of chapters and verses? If the teacher of Chemistry, for example, were to insist upon the students studying 100 pages of Miller, 50 pages of Roscoe, two books of Gerhardt, the correspondence of Lavoisier, and the life of Berzelius, before presenting himself for examination, he would be looked upon as slightly deranged; and yet this is precisely what is done by our classical friends. A chemist can tell in half an hour whether the candidate is prepared to go on with a certain class; and he cares not how, when, or where the applicant obtained the knowledge. Not so our classical friends; they insist upon chapter and verse as if there were a charm in the prescribed number—and by so doing they do great harm to our schools. A friend of mine desired to put his son at a select school, and had a long conversation with the principal in reference to the studies he would have to pursue in order to fit him for college. The principal had the experience of thirty years in his calling, and

knew precisely what was required. He produced his scheme of hours, and convinced the parent that in order to fit his son for college it would be necessary for him to devote a certain number of hours to the reading of a prescribed number of pages and verses of Latin and Greek; and to do this no deduction could be safely made. He showed that the average attendance of boys was about 6,000 hours, and by assigning to each hour its particular work, if not interrupted by accident or illness, the pupil would be able to come up to the prescribed standard. My friend tried to see if a few minutes could not be gained for a small amount of science, but the teacher, with his experience of thirty years, was inexorable, and he could not crowd in a knowledge of this world into the course of studies even edgewise. It has been sometimes said that the most ignorant members of our community are our men of education; and after looking over the scheme of studies which the victims of liberal education are obliged to follow, the paradoxical remark would almost appear to be true. It may therefore be asked, What change the advocates of reform would propose? I cannot attempt to answer this question for all parties, as there is little uniformity of belief on the subject; but it may be well to state the case of a prominent party in the modern agitation. We have a large class among us who admit the culture to be derived from the study of language, and who would not on any account banish Latin and Greek from the curriculum; but they would remove that study to a later part of the course, and replace it by scientific subjects. They think that those subjects which cultivate and strengthen the powers of perception, observation, and judgment, should be taught first. They would instruct the youth in a knowledge of the laws of health or physiology; they would have him know something about plants, animals, minerals, and the commonest laws of chemistry and physics, so that if the pupil is compelled to leave school at an early age, he would know how to take care of mind and body, and be enabled to turn his knowledge to some account. They would commence the study of Latin and Greek at a period when the mind is more mature, and thus avoid the enormous waste of time, the bad habits of droning over lessons, and the monopolising character of the present system. There are so many instances of persons who commenced the study of the classics at mature years, who have excelled all others, that the advocates of postponing languages to the latter part of a boy's course appear to be justified in their claim. If the study of Latin and Greek could be commenced after the student enters college, it is believed that more real progress would be made in the four years of the college course than is effected under the present arrangement of devoting ten years of a boy's life to this study. This is the compromise that many good men advocate. They wish the preparatory schools to be wholly given up to mathematical, scientific, and English studies, and to have the colleges assume the charge of the classics. Instead of devoting every hour of the preparatory course to languages, they would give the time to the sciences, and they would demand a knowledge of the general principles of science as a requisite for admission to college. This would be turning the tables entirely, and would afford scientific men a chance to try the effect of the modern education. The other side have had it all their own way for a long time, and it would appear to be no more than fair for them to let people of different views have a chance. Such a radical change as this cannot be accomplished at once. It would demand immense moral courage on the part of the trustees of a college to expose themselves to the cry of lowering the standard of study. They would have the alumni of existing institutions and the prejudices of the whole community against them, and it would require a generation before the majority would become reconciled to the new order of things. Another obstacle would also arise at the outset, and that would be the difficulty of securing competent teachers of the natural sciences. It is this obstacle that has stood in the way of the introduction of the study of science in our schools. There are far too few teachers. To surmount this difficulty in the city of New York a normal college for females and a free college for males have been established, and scientific schools have been founded in all parts of the country. These institutions are destined to work a great revolution. As soon as they have trained a sufficient number of teachers, we shall find our public schools affording a better education than at present, and their example will have to be followed by the owners of private schools, who desire to keep up with the progress of the age. What we want is science taught in plain English, and there is every prospect of our speedily attaining the desired end."

SCIENTIFIC SERIALS

Numbers 8, 9, and 10 of the 27th volume of the *Proceedings of the Swedish Academy of Sciences* (Öfversigt af Kongk. Vetenskaps Akademiens Förhandlingar) which have just reached us, contain several valuable contributions to science. The most important of these relate to zoological subjects. Thus we find from M. Anton Stuxberg the first portion of a paper modestly described as a contribution to the Myriopodology of Scandinavia, but containing a synonymic revision, with descriptions, of the Swedish Chilognatha, under which the author recognises the genera *Julus*, *Isobates*, *Blaniulus*, *Polydesmus*, *Craspedosoma*, *Glomeris*, *Polyxenus*, and *Polyzonium*, including in all eighteen species. M. G. Lindström contributes a paper on opercular structures in some recent and Silurian corals, in which he refers especially to *Goniophyllum pyramidale* and *Cystiphyllum prismaticum*. From M. Gustaf Eisen we have a most valuable contribution to the Oligochætal fauna of Scandinavia, illustrated with numerous figures on seven plates, and containing a monograph of the Scandinavian species of the genus *Lumbricus*, of which eight are recognised by the author. As the characters are given in Latin, and most of the species are found in this country, this paper will be of particular value to British naturalists. One species, *Lumbricus purpureus*, is described as new.—M. J. E Areschoug communicates a list, with remarks, of a series of algæ collected by Dr. Hedenborg at Alexandria.—The longest paper is an account, by Prof. A. E. Nordenskiöld, of the Swedish Expedition to Greenland in 1870. This paper contains some interesting observations, illustrated with diagrams, on the glacial phenomena of Greenland; the remarks on the geology of the more interesting parts of the coast, especially those where fossil plants are found, are also of great importance; as is the account given of the supposed meteoric iron-stones of enormous size which have lately attracted so much attention. Analyses of the material of these masses by the authors, T. Nordström and J. Lindström, are given. Lists of the land plants and algæ collected on the expedition, and of the microscopic algæ obtained from the inland ice, form an appendix to the paper. M. P. T. Clevi contributes a paper on platinum-bases containing organic radicals, and M. G. R. Dahlander some investigations relating to the mechanical theory of heat.

THE *American Naturalist* for January (vol. vi., No. 1) commences with Prof. Agassiz's letter, already printed in our columns, on Deep-sea Dredgings. Mr. F. W. Putman follows, with an extremely interesting and well-illustrated article on the Blind Fishes of the Mammoth Cave of Kentucky and their Allies, a sequel to Mr. Packard's paper on the Blind Insects of the same locality in the previous number. Dr. R. H. Ward describes a new erecting arrangement, especially designed for use with binocular microscopes. One of the most interesting articles in the number is on the Rattlesnake and Natural Selection, by Prof. N. S. Shaler, who, from observation of the animal in its native haunts, regards the rattle as a useful appendage, imitating the note of the Cicada, and thus attracting birds which are in the habit of preying on that insect. Prof. Shaler states that, without committing himself to a belief in the sufficiency of natural selection to account for the existence of the snake's rattle, he has been driven step by step from a decided opposition to the whole theory, and compelled to accept it as a *vera causa*, though still thinking it more limited in its action than Mr. Darwin believes. There is the usual supply of interesting short notes on the various branches of natural history.

Journal of the Scottish Meteorological Society, October 1871, New Series, No. xxxii.—This number of the Journal of the Scottish Meteorological Society contains a paper by Mr. Buchan, the secretary, "On the Rainfall of Scotland," based on observations made at forty-six places during long series of years. The questions of droughts and excessively wet years are dealt with. As regards their geographical distribution it is shown that some have been felt over the whole of Scotland, whilst others have been restricted to the west or to the east of the country, or within still narrower limits; and as regards their recurrence, that there has been no perodicity observed, and that there is nothing in the observations of the past forty years to sanction the opinion that there has been any progressive increase or decrease in the Scottish rainfall. The important engineering question of the deficiency of the three driest consecutive years' rainfall from the average is carefully examined, and the conclusion is arrived at, that in estimating the rainfall of the three driest consecutive years, it will not be safe to deduct less than one-fourth from the

average annual rainfall. Mr. Buchan contributes another paper "On the Temperature of the Soil compared with that of the Air," being a discussion of series of observations made twelve times daily in different parts of Scotland, at the instance of the Marquis of Tweeddale, president of the society. From the observations it is seen that the surface temperature of the soil is considerably colder than the air resting on it in winter, and considerably warmer in summer; and from the relations of the temperature of the soil to that of the air during changes of weather, some interesting results are drawn with reference to the influence of solar and terrestrial radiation on climate.—A brief notice of the winter climate of Malaga, detailed notes of the weather of the quarter, and tabulated returns from ninety-one stations, including several highly important stations in Iceland, Faro, and regions bordering on the Mediterranean, make up the number.

Journal of the Chemical Society, December 1871.—This number commences with a paper by Watson Smith, "On the Distillation of Wood," and although of considerable technical interest it does not present any new features.—A paper on Anthraflavic Acid follows, by W. H. Perkin. This is a substance which occurs in the artificial alizarin of commerce. Two distinct formulæ have already been assigned to this body by Drs. Schunck and Liebermann. This communication proves conclusively that these formulæ were wrong, and that in reality this acid is isomeric with alizarin, but unlike that body it possesses no tinctorial power.—Dr. Armstrong contributes a paper on the action of Nitric Acid on the Dichlorophenol Sulphuric Acids. The results obtained are very interesting, but seem to cast some doubt on the theoretical speculations of some German chemists on the constitution of those bodies.—The abstracts in this number occupy 100 pages, and comprise many papers of great value.—E. Baudiment has made an extensive series of experiments on the intimate action of substances which assist the decomposition of potassic chlorate and the disengagement of oxygen. Many bodies were tried, some of which, as cupric or manganic oxides, when heated with potassic chlorate, as is well known, yield oxygen very readily, in this case, when the temperature reaches a definite point, a sudden rise of 50° or 60° takes place with a tumultuous evolution of gas. The author has found that the decomposition of potassic chlorate is always accompanied with a disengagement of heat, so that this substance may be called an endothermic compound.

THE *Monthly Microscopical Journal*, February 1872.—"On the relation of Nerves to Pigment and other Cells or Elementary Parts," by Dr. Lionel S. Beale, F.R.S. After alluding to the tendency of opinion in these days to favour the conclusion that the finest branches of nerve fibres come into structural relation with the active elements of other tissues, Dr. Beale affirmed his opinion that, whatever may be the influence produced by the nerves upon the structure, he does not think it depends upon continuity of substance between the nerve and the tissue affected.—"Report on Slides of Insect Scales," sent to the Royal Microscopical Society by the Chevalier de Cerbacq, examined by Henry J. Slack.—"On the Structure of the Stems of the Arborescent *Lycopodiaceæ* of the Coal Measures," by W. Carruthers, F.R.S.—"On a Leaf-Bearing Branch of a Species of *Lepidodendron*." These papers contain the results of an examination of a series of specimens from Mr. John Butterworth, of Shaw, near Oldham.—"On Bog Mosses,'' by Dr. R. Braithwaite, F.R.S., part iii., Monograph of the European species. This paper includes an enumeration of species, and full description of *Sphagnum cymbifolium*, the first in the series.—"The advancing powers of Microscopic Definition," by Dr. Royston Piggott. This is a further contribution to the vexed question of beaded scales, and may be taken as a summary of Dr. Royston Piggott's views, of which the first portion appears in the present number of the journal.—"Microscopical Object-glasses and their Power," by Edwin Bicknell; "Remarks on a Tolles' Immersion, $\frac{1}{16}$," by Edwin Bicknell; "Maltwood's Finder Supplemented," by W. K. Bridgman. This latter communication offers a plan by means of which two correspondents may bring their "Maltwoods" into relation with each other, supposing that their indications do not coincide.—"On a new Micro-telescope," by Prof. R. H. Ward, reprinted from the "American Naturalist." This number of the journal is illustrated by four plates.

THE *Journal of Botany* for February is ornamented by a very good portrait of the late editor, Dr. Berthold Seemann. The original articles are fewer than usual, including only the conclusion of Mr. J. G. Baker's paper on the Botany of the Lizard Peninsula, and a case of poisoning by the seeds of *Macrozamia spiralis*, by Dr. George Bennett. There are, however, a good many interesting short notes and several valuable reprints, including Dr. W. R. McNab's Histological Notes, read before the Botanical Society of Edinburgh; a list of new species of phanerogamous plants published in Great Britain in the year 1871 in the *Annals and Magazine of Natural History*, *Botanical Magazine*, *Floral Magazine*, *Gardeners' Chronicle*, Hooker's *Icones Plantarum*, *Journal of Botany*, *Journal of the Linnean Society*, and *Refugium Botanicum*; and Canon Kingsley's admirable address to the Winchester and Hampshire Scientific and Literary Society, on Bio-Geology.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, February 21.—Prof. Ramsay, F.R.S., vice-president, in the chair. The following communication was read:—"Migrations of the Graptolites." By. Prof. H. Alleyne Nicholson, M.D. The author commenced by stating that the occurrence of the same species of marine animals in deposits in different areas is now generally regarded as evidence that such deposits are not strictly contemporaneous, but rather that a migration from one area to another has taken place; this migration he thought would probably in many cases be accompanied by modification. Applying these principles to the Graptolites, he endeavoured to show in what directions their migrations may have taken place. He excluded from the family Graptolitidæ the genera *Dictyonema*, *Dendrograpsus*, *Callograpsus*, and *Ptilograpsus*, and stated that the family as thus limited extended from Upper Cambrian to Upper Silurian times. The earliest known Graptolites were those of the Skiddaw Slates, which he thought would prove to belong to the Upper Cambrian series. The Skiddaw area he considered to extend into Canada, where the Quebec group belongs to it. Genera of Graptolites belonging to this area are represented in Australia, and this the author regarded as indicative of migration, but in which direction was uncertain. Having discussed the forms of Graptolites characteristic of the deposits in the Skiddaw-Quebec area, the author proceeded to indicate the mode in which the family is represented in the areas of deposition of the great Silurian series, namely, the Llandeilo areas of Wales and Scotland, the Coniston area of the North of England, the Gala area of South Scotland, the Hudson-River area of North America, and the Saxon and Bohemian areas, giving under each of these heads a list of species, with indications of their probable derivation. Mr. Etheridge commented on the importance of Dr. Nicholson's paper, and on the difficulties attending the study of the Graptolitidæ. The migration of these organisms appeared to him to be very difficult to establish, especially in connection with their extension both eastwards and westwards. Mr. Hughes believed that if we could discover the original of any species, we should see a small variety appearing among a number of forms not very different from it, and from which it had been derived; but when the variety had prevailed, so as to be the dominant form, we were far on in the history of the species; that it was a great assumption to fix upon any bed we now know as representing the original source of any group; that we know too little about the chronological order of the geological divisions referred to to reason with any safety on the migration of Graptolites from one era to another; that the term *Lower* Llandeilo, for instance, was very unsatisfactory as used in the paper; there was nothing lower than the Llandeilo Flags at Llandeilo; and where older beds occurred in Scotland and elsewhere, it was not at all clear that the equivalent of the Llandeilo Flags was present at all. He differed also altogether from the author as to the position of the Dufton Shales, and criticised the views of the author as to the range of some species. He thought that M. Barrande's theory of the colonies was borne out by the study of the Graptolites, but that we had not sufficient data to speculate as to the areas in which they made their first appearance, or the order of their geographical distribution. Prof. Duncan observed that at the present time there was, among other forms, quite as great a range for species as that of the Graptolites pointed out by the author. Having looked through all the drawings of Graptolites that he could meet with, he had found none whatever that were accurate; and he had moreover never in any specimens discovered such cups or *calices* between the

serrations as were always attributed to these organisms. From all he had seen he was led to the conclusion that the projections on the Graptolites bore the same relation to the central stem as those of some of the Actinozoa. These latter also, like the Graptolites, seemed to prefer a muddy sea. Professor Duncan also suggested that the Graptolites were really the remains of the filiform polypiferous parts of floating Hydrozoa. Prof. Morris regarded the paper as mainly suggestive. It was on all hands agreed that there were in Britain two principal zones in which graptolitic life was most abundant; and the same held good in America. Both these seemed to be homotaxially related. M. Barrande had long since pointed out the probable emigration of many of the Bohemian species from the British area; and there could be no doubt of there being many species common to Europe, America, and Australia. This afforded strong evidence in favour of some such theory as that of migration. He cautioned observers as to taking careful notice of the manner in which Graptolites are presented in their matrix; for when seen from three different points of view, they exhibited such differences that three species might be made from one form of organism. Mr. Gwyn Jeffreys mentioned the wide distribution of marine Hydrozoa by means of winds and currents, as illustrative of the history of Graptolites, the dispersion of which might have arisen from similar cause, and not from migration. Mr. Prestwich commented on the uncertainty of our knowledge with regard to Graptolites, and consequently regarded speculation on the subject of their migration as premature. He instanced *Cardita planicostata*, which was formerly regarded as having originated in the Paris basin and come thence into England, but which had since been found in far earlier beds in Britain; so that the presumed course of its migration has been reversed. Mr. Hicks remarked that the rocks referred by the author to the Upper Cambrian were in reality the lowest of the Silurian series, and that the Graptolitidæ were exclusively a Silurian family. Mr. Hopkinson also made some remarks both on the distinction of different species of Graptolites and on their distribution. He regarded the Quebec area as that in which these forms had originated. The Chairman commented on the great want of accord among those who had studied Graptolites, not only with regard to their structure, but to their distribution in different horizons. He thought that the suggestion of the author, as to modification of form during migration having taken place, seemed to throw some light on the subject. He could not regard two districts now only separated by the Solway Firth as constituting two geographical areas so distinct that the occurrence of the same species in both could with propriety be held to be due to migration. The phenomena in the other cases seemed to him quite as much in accordance with distribution from some common centre as with migration along any line connecting two spots where Graptolites are now found. He thought that the recurrence of these forms on different horizons in Cumberland was to be accounted for by the fact that most of the rocks which intervened between the shales containing these organisms were merely sub-aërial volcanic beds, on which, after submergence, these muddy shales had been deposited.

Entomological Society, February 19.—Prof. J. O. Westwood, president, in the chair.—Drs. Ransome and Livett, and Messrs. Rothera and Jenner, were elected subscribers to the society.—Mr. F. Smith made some observations respecting the occurrence of two pupæ in one large common cocoon of *Bombyx mori* from China. The examples had been found amongst silk-waste in a London warehouse, and this waste had been attacked by mice, which fed upon the dead chrysalides. He further remarked that, occasionally, two or more swarms of wasps united in building a common nest, and also that broods of different species of wasps could be induced to act in concert, the result being that when these wasps used different building materials, a parti-coloured nest was produced.—Mr. Butler exhibited drawings of a large grub, apparently the larva of some species of Ichneumonidæ, which had emerged from the larva of the common "buff-tip" moth (*Pygæra bucephala*), which it nearly equalled in size.—Dr. Buchanan White communicated extracts from his note-book respecting the habits of a species of ant as observed at Capri in 1866, confirming Mr. Moggridge's recent observations as to the grain-storing habits of these ants. Mr. Horne had observed a similar habit in certain Indian ants.—Prof Westwood exhibited type-specimens and drawings of the animal from Madagascar, upon which Latreille founded his genus *Prosopistoma* as pertaining to the *Crustacea*; and made some remarks thereon connected with the assertion of a French entomologist, Dr. Joly, that these creatures, and "le Binocle" of the neighbourhood of Paris, described by Geoffroy, are in reality the earlier stages of species of *Ephemeridæ*. Prof. Westwood was scarcely able to believe that this association was founded upon facts, though he was not disposed to express any opinion as to their actual affinities.—Mr. Müller read some remarks on the habits of certain gall-producing saw-flies of the willow, which are said to avoid those portions of the trees that overhang water, and suggested a practical application of the theory to save choice fruit-trees from the attacks of insects, by surrounding them with glass at the base, it being well known that glass is often mistaken for water by aquatic insects.

Anthropological Institute, February 19.—Sir John Lubbock, Bart., F.R.S., president, in the chair. Messrs. C. Bowley, R. J. Nunn, Edward Harris, J. E. Price, and J. P. Steele, were elected members. Mr. H. H. Howorth read a paper entitled "Strictures on Darwinism. Part I.: Fertility and Sterility." After a brief statement of the evolutionary theory of Mr. Darwin, which was the old-fashioned theory of Malthus pressed to its utmost limits, viz., that in the struggle for existence which is always going on everywhere the weak elements go to the wall and are gradually eliminated whilst the strong survive, the author stated his intention in the present paper to confine his examination to one case in its concrete form. He criticised the argument that physical vigour, health, and strength had, in the struggle for existence, a tendency to prevail to the expulsion and eradication of weakness and debility, and he held that the reverse was the truth as regarded the large majority of cases, and the paradox was the same in substance as that maintained by Mr. Doubleday in his true Law of Population. It was shown that the gardener, who was an empirical philosopher, in his experience of cultivated plants, was fully aware of the truth of the principle advocated by the author, and a great number of instances were cited in illustration. Passing from the vegetable to the animal world, he showed how stock-keepers and breeders had accumulated much sound experience, which corroborated that of the gardener in regard to plants. It was a golden rule with them to keep their animals weak and in a state of depletion if they wished them to breed freely. Pure breeds were seldom very fruitful, they were notoriously pampered and highly fed; but when turned into coarse and scanty pastures their rounded sides became denuded of flesh and the animals bred more freely. The same principle obtained with man. It was in the crowded alleys and among half-starved or ill-fed populations that fertility was greatest. The author had high authority for stating that as a general rule convalescent persons—those recovering from prostrating diseases—were very fertile. On the other hand, with the rich and well-to-do, especially among families whose position for some generations had been prosperous, comparative sterility prevailed. Illustrations of that dictum were drawn from the writings of physiologists, from statistics, from the genealogical histories of the nobility and gentry, and were sustained by lengthened argument. National and ethnic tendencies to fertility or sterility were surveyed by the author, *e.g.*, among the Irish, various Black and savage peoples, Americans aboriginal and modern, the Slaves, and various Russian tribes. In conclusion, the arguments were thus summarised: that sterility is induced by vigorous health and by a plentiful supply of the necessaries of life, while fertility is induced by want and debility, and that this law acts directly against Mr. Darwin's theory, inasmuch as it is constantly recruiting the weak and decrepit at the expense of the hearty and vigorous, and is thus persistently working against the favourite scheme of Mr. Darwin, that in the struggle for existence the weak are always being eliminated by the strong.

MANCHESTER

Literary and Philosophical Society, February 20.—Mr. E. W. Binney, F.R.S., president, in the chair. The president said that at the meeting of the society on the 9th of January last he alluded to the probability of the genus *Zygopteris* being found in the limestone nodules of the Foot Mine near Oldham. He had lately had an opportunity of inspecting the collection of Mr. James Whitaker of Watershedding, and he there recognised a specimen of the *Zygopteris Lacattii* of M. Regnalt. There was a difference between the Autun and Oldham specimens; for whilst the vascular bundles in the petiole of the former were shaped like a double anchor, in the latter they came nearly together and formed a circle; but he thought this difference scarcely sufficient to form another species.—Dr. J. P. Joule, F.R.S., described some experiments he had been making

on the polarisation by frictional electricity of platina plates, either immersed in water or rolled together with wet silk intervening. The charge was only diminished one half after an interval of an hour and a quarter. It was ascertained both in quality and quantity by transmitting it through a delicate galvanometer. He suggested that a condenser on this principle might be useful for the observation of atmospheric electricity.—"On an Electrical Corona resembling the Solar Corona," by Prof. Osborne Reynolds.—"On the Electro-Dynamic effect, the induction of Statical Electricity causes in a moving body. The induction of the Sun a probable cause of Terrestrial Magnetism," by Prof. Osborne Reynolds.

EDINBURGH

Royal Physical Society, February 28.—Dr. James M'Bain, president, in the chair. The following communications were read.—"On the Dentition of *Echinorhinus spinosus*," by Prof. Duns. Dr. Duns has obtained two specimens of this rare shark in the Firth of Forth, one in 1868 and another in 1871. The former is in the Scottish Natural Museum, the latter in the Museum of the New College. The specimens noticed by Yarrell were referred to, and the form of the teeth of the 1868 example shown. The remarks of Agassiz were quoted on the resemblance of the teeth of *Echinorhinus* to those of his genus *Goniodus*. It was shown, that while in other specific features the specimen of 1871 resembles those of that got in 1868, it differs very widely in the form of the teeth.—"On Garnetiferous Limestone, Balmoral," by Prof. Duns.—"On the Preservation of Compound Ascidians," by Mr. C. W. Peach. Mr. Peach stated that when living at Cornwall he was much struck by the beauty of the compound ascidians, so abundant on rocks, &c., between tide-marks there, and that he was perfectly aware that the beauty of the colours and flower-like systems of these lovely objects was always lost, whether they were preserved in spirits or any other fluid. He thought of Canada balsam—the great difficulty of contending with wet objects suggested itself. He, however, tried, and so far succeeded, by laying them on glass, (when detached from the rocks), after squeezing out as much as possible of the moisture by first laying them in cotton or linen rag between sheets of blotting paper, changing these as often as required, and doing all as quickly as possible, after taking the object from the sea. Thus dried, they were placed on glass covered with warmed Canada balsam, and covered with another similarly prepared plate of glass, on which sufficient balsam was melted to cover up completely the specimen. It is then allowed to cool under slight pressure, the superfluous balsam scraped off, and sealing-wax put round the edges to form a cell, and thus they were preserved. He exhibited several specimens—some preserved twenty-five years ago—of Leptoclinum, Botryllus, Didemnum, Paracidra, &c., in a beautifully preserved condition.—Mr. Peach exhibited a number of fossil plants he had collected last summer from the coal-fields of Edinburgh, Slamannan, Bathgate, and Devonside near Tillicoultry.—"On the Phosphate Deposits of South Carolina," by Prof. Pratt, Charleston, U.S.—Mr. John Hunter exhibited a series of fossils from the same region.

DUBLIN

Royal Irish Academy, February 12.—Rev. J. H. Jellett, president, in the chair. Dr Eugene A. Conwell read a paper on the identification of the ancient Cemetery at Lougherew, Co. Meath.—Dr. W. Frazer read notes on several finds of silver coins lately made in Ireland.

PARIS

Academy of Sciences, February 19.—The dispute concerning the accuracy of the results published by the Paris Observatory was carried on rather briskly by MM. Serret, Le Verrier and Delaunay.—A note by M. Zeuthen on the determination of the characteristics of the elementary systems of cubics was presented, with remarks by M. Chasles.—M. Ciotti claimed the originality of his researches on the employment of vibratory elastic laminæ as a means of propulsion.—M. Delaunay communicated some remarks on the experiments of M. Wolf, on the reflecting power of silvered glass mirrors.—Numerous reports on the aurora of February 4 were presented, and also a note by Marshal Vaillant on the phenomena which give rise to auroras, a note by M. H. Tarry on the origin of polar auroras, and a memoir by M. Silbermann on the facts from which we may deduce a theory of auroræ borealis and australis founded on the existence of atmospheric tides, and the indication, by means of auroras, of the existence of flights of meteors in proximity to the terrestrial globe.—Marshal Vaillant regarded auroras as produced by the reflection from the surface of the terrestrial atmosphere of the light produced by electrical or magnetic currents. M. Tarry ascribes to these phenomena a cosmical origin.—A note by M. J. L. Soret on the induction currents produced in the coils of an electro-magnet when a metallic mass is set in rotation between its poles was read.—M. H. Sainte-Claire Deville presented a note by M. E. Branley on the measurement of the polarisation in a voltaic element.—A note by M. Respighi on the spectral analysis of the zodiacal light was read, in which the author detailed some interesting observations on the spectral phenomena presented by the zodiacal light and auroras tending to indicate the identity of origin of the two phenomena.—M. Delaunay presented a note by MM. Loewy and Tisserand on the search for the last planet (99) Dike.—MM. J. Pierre and E. Puchot communicated some facts in the history of propylic alcohol, relating chiefly to the behaviour under distillation of the so-called monohydrate of that body.—M. G. Tissandier communicated a note on a new mode of producing anhydrous protoxide of iron by the action of carbonic acid upon iron heated to redness. The author describes the properties of the oxide thus prepared.—A memoir was read by M. E. Duclaux on iodide of starch, which he does not regard as a regular chemical compound.—A note by M. Blondlot on the alcoholic fermentation of sugar of milk was read. The author described the fermentation of milk when agitated from time to time, by means of a ferment apparently proper to it, and stated that this fermentation was continued by the addition of sugar of milk or glucose to the fluid after the cessation of the first fermentation. He obtained alcohol by the distillation of the fermented product, and regarded his results as favourable to the theory of fermentation of M. Pasteur.—M. Pasteur criticised the recent communications of M. Fremy on the subject of fermentation, discussing his experiments *seriatim*, and indicating objections to them.—M. S. de Luca presented some investigations upon the composition of the gases which are evolved from the fumaroles of the solfatara of Pozzuoli, upon which M. Boussingault made some remarks.—The processes for the preservation of wines by the application of heat formed the subject of notes by M. A. de Vergnette-Lamotte and by Dr. Bart.—M. E. Alix noticed the existence of the depressor nerve in the hippopotamus, and stated that it resembles that of the horse in arrangement, but is thinner coinciding with the small size of the primitive carotid.—M. A Béchamp presented some observations on a recent note by M. de Segnes upon microzymes.

February 26.—The following mathematical papers were read:—An exposition of a geometric theory of the curvature of surfaces, by M. A. Mannheim, presented by M. Serret; a note on some relations between the angular quantities of convex polyhedra, by M. L. Lalanne; and a determination of the characteristics of the elementary systems of cubics, by M. Zeuthen, communicated by M. Chasles.—M. de Saint Venant read a memoir on the hydrodynamics of streams.—M. Phillips presented a note on the governing spiral of chronometers, and M. de Pambour a second paper on the theory of hydraulic wheels, relating to the reaction wheel.—A letter from Father Secchi on the aurora of February 4, and on some new results of spectrum analysis, was read, containing a description of the appearances observed at Rome, with a notice of the phenomena presented by spectrum analysis, and a discussion of the supposed relation between auroras and the solar protuberances, which the author is not inclined to accept. In a postscript M. Secchi calls attention to the appearance of remarkably distinct bands and lines upon the planet Jupiter.—A communication was read from Prof. Piazzi Smyth, on the brilliant yellow band in the spectrum of auroras, which he stated to be of constant occurrence, and to fall always upon the line 5579.—M. A. Laussedat also presented a memoir on the aurora of February 4, and M. C. Sainte-Claire Deville a continuation of M. J. Silbermann's memoir on the theory of auroras, and on the indication by their means of the existence of flights of asteroids in proximity to the earth.—M. C. Sainte-Claire Deville also read a note on the probable application of quadruple, dodecuple, and tridodecuple symmetries, or of periods of 90, 30, and 10 days, to the mean returns of the electrical phenomena of the atmosphere, such as storms and auroras.—M. E. Becquerel presented a memoir by M. G. Planté, on the employment of secondary currents to accumulate or transform the effects of the galvanic battery, containing the description of improvements in

the arrangements previously suggested by him.—M. H. Sainte-Claire Deville communicated a note by M. J. M. Gaugain on the electromotor forces developed by the contact of metals with inactive fluids, containing the discussion of results obtained with plates of platinum in distilled water.—The question of priority in the invention of the method of preserving wines by the action of heat was treated at some length by M. Balard, to whom M. Thenard replied.—M. Tellier forwarded a further communication on his system of producing cold by the evaporation of ether, assisted by compressed air.—M. Wurtz presented a note by M. E. Reboul on two new isomers of bromide of propylene.—M. J. Personne read a note on iodide of starch, in answer to one presented by M. Duclaux at the last meeting. M. Personne claims to have arrived six years ago at the conclusion that the so-called iodide of starch is not a chemical compound.—A note by M. Marey, on the determination of the inclinations of the plane of the wing at different moments of its revolution was read.—M. C. Bernard presented a third note by M.P. Bert on the influence which changes in barometric pressure exert upon the phenomena of life, in which the author described the effects produced by exposing small animals to various degrees of atmospheric pressure. He has found that up to a pressure of two atmospheres sparrows die when the air in the receiver contains 25 per cent. of carbonic acid, but that above this limit and below a pressure of 25 centims., this law does not apply. In the former case the birds perish partly by the toxical effects of an excess of oxygen, and in the latter by a privation of oxygen.—M. C. Bernard also communicated a note by M. N. Gréhant on the respiration of fishes, containing a statement of the curious fact that fishes in respiration can avail themselves not only of the oxygen dissolved in the water, but also of that held by the red corpuscles of the blood of other animals when these are mixed with the water.—A note by MM. L. Labbé and G. Guyon on the combined action of morphine and chloroform, was also presented by M. C. Bernard. The authors state that a state of perfect anæsthesia may be produced and sustained for a long time without the usual danger, by administering a subcutaneous injection of hydrochlorate of morphine about a quarter of an hour before the exhibition of chloroform.—M. A. Béchamp read a paper "On the Essential Nature of the Organised Corpuscles of the Atmosphere, and on the part which belongs to them in the phenomena of Fermentation."—M. S. Meunier presented a note on the existence of bauxite in French Guiana.

VIENNA

Geological Institution, February 6.—Dr. Neumayr, "On the Jurassic Provinces of Europe." The author stated the different development of the Jurassic strata in three regions of Europe. To the Mediterranean province belong the Jurassic beds of Spain, and of the Alpine and Carpathian districts; secondly, the middle European province is formed by the Jurassic beds of England, France, and Northern Germany; while to the third, the Russian province, belong the Jurassic beds of Russia, as well as those of Spitzbergen and Greenland. The only really important diversity between the Jurassic strata of these provinces is founded, as he shows, on differences in the zoological characters of their faunas. Thus, for instance, the most prevalent peculiarity of the Mediterranean province is the presence of Ammonites of the two genera, Phylloceras (*Heterophylli*) and Lytoceras (*Fimbriati*), which abound in almost all members of the Jurassic formation in the Alps and Carpathians, while they are almost entirely wanting in the middle European province. The Russian province, on the contrary, is chiefly characterised by the absence of reef-forming coral and some other peculiarities. It is impossible to account for this difference by the supposition of land having separated the Jurassic seas of the different provinces. The fact that along the line of separation between the Mediterranean and middle European provinces, from the South of France to the Crimea, strata of both provinces approach very near, even to a few miles, excludes this supposition. The only possible mode of explanation the author finds in accepting in the Jurassic period climatic differences in the zones from north to south. The strict separation of both faunas along the said line may be explained, he thinks, by a great stream of warm water, which produced similar effects to the Gulf Stream in our time.—Dr. G. Pilar, "On the Tertiary deposits in the valley of the Culpa, in the environs of Glina, in Croatia." Very instructive sections have been denuded in these deposits by the Culpa river. The marine beds, as well as the Sarmatic and the Congeria beds are developed; all abound with fossils.

DIARY

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 8 30.—On the Organisation of the Fossil Plants of the Coal Measures. III. Lycopodiaceæ, by Prof. W. C. Williamson, F.R.S.
SOCIETY OF ANTIQUARIES, at 8.30.—Exhibition of a large collection of Photographs and Drawings of Irish Architectural Remains anterior to the 12th Century, made by the late Earl of Dunraven, F.S.A., with Remarks by Miss Stokes
CHEMICAL SOCIETY, at 8.
LINNEAN SOCIETY, at 8.—Revision of the Genera and Species of Scilleæ: J. G. Baker.—Andræcium in Cochlostema: Dr. Masters.
LONDON INSTITUTION, at 7.—A Vindication of our Monetary Standard, with an Exposition of its Internal Relations: J. A. Franklin.

FRIDAY, MARCH 8.

ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.
ASTRONOMICAL SOCIETY, at 8.
QUEKETT MICROSCOPICAL CLUB, at 8.
ROYAL INSTITUTION, at 9.—On the Effect of certain Faults of Vision on Painting, with especial reference to Turner and Mulready: K. Liebreich.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Demonology: M. D. Conway.

MONDAY, MARCH 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.
ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.

TUESDAY, MARCH 12.

PHOTOGRAPHIC SOCIETY, at 8.—Retouching, its Use and Abuse: Valentine Blanchard.
ROYAL INSTITUTION, at 3.—On the Circulatory and Nervous Systems: Dr. Rutherford.

WEDNESDAY, MARCH 13.

ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.
SOCIETY OF ARTS, at 8.—On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom: Leone Levi.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
MATHEMATICAL SOCIETY, at 8.—Shall the Society apply for a Charter?
ROYAL INSTITUTION, at 3.—On the Chemistry of Alkalies and Alkali Manufacture; Prof. Odling, F.R.S.

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ERRATA.—P. 341, first col., line 32, for "and should be changed," read "and should not be changed." P. 338, first col., line 3, for "J. Murray" read "Tinsley Brothers."

NOTICE

We beg leave to state that we decline to return rejected communications, and to this rule we can make no exception. Communications respecting Subscriptions or Advertisements must be addressed to the Publishers, NOT *to the Editor.*