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THURSDAY, FEBRUARY 20, 1873

THE PRESERVATION OF OUR NATIONAL MONUMENTS

THE necessity of some measures being taken for the preservation of our national pre-historic monuments is constantly being forced upon public attention by the acts of destruction so frequently reported in the newspapers, and which, it would appear, the power of public opinion is by itself unable to prevent.

We have only to refer to any archæological work which treats of our cromlechs and dolmens, and other megalithic monuments, to see at once how fearfully many of them have been mutilated, if they have not been absolutely destroyed within the last century or two. The disappearance of the monolith near Kit's Coty House, which, though fallen in Stukeley's time, was still there to mark what was then known as "the general's grave;" the hopeless confusion into which the "Countless Stones," also near Aylesford, have been thrown; the cairns within the circle, known as Long Meg and her Daughters, which, since Camden's time, have vanished, while the Daughters appear to have been reduced in number from 77 to 68; the double row of immense stones near Shap, the destruction of which has been so great that a village has been almost entirely built out of their remains;—these are but a few examples of this kind culled at random from Fergusson's "Rude Stone Monuments."

It was, moreover, only last year that a portion of Avebury, a monument perhaps only second in importance to Stonehenge, was threatened, and was only saved for posterity by the public-spirited liberality of Sir John Lubbock, who purchased the site.

With barrows and earthworks the destruction has been equally rapid, though less noticed. We have, however, seen an expostulation in the *Times* on the subject of the vallum of an ancient circular camp being converted into bricks, and the threatened destruction of Cæsar's Camp at Wimbledon is still a matter of public interest.

It is, perhaps, rarely the case that these monuments are destroyed in a merely wilful manner; it is usually from economical motives. The barrows offer a mound of soil well adapted for being carted away to give a top dressing to some neighbouring field, and there is also the secondary advantage, that their site, after the removal of the mound, offers no impediment to the passage of the plough. The stones of the megalithic monuments offer supplies of material both for the purposes of building and the repair of the neighbouring roads. As it was with "the Egyptian mummies, which Cambyses or Time had spared and which Avarice now consumeth," so it is with these rude monuments of our forefathers. When the belief was strong that "Mizraim cured wounds," there was some excuse for "mummies becoming merchandise," and "Pharaoh being sold for balsams;" but to dress our fields with the sepulchral mounds of our predecessors, and to break up their monuments for the repair of our barns and roads, seems to us what Sir Thomas Browne would have stigmatised as a worse than "irrational ferity."

It is with a view to preventing such barbarisms that Sir John Lubbock has introduced a Bill in the present Session of Parliament, to make provision for the preservation of certain national monuments, which has now been read a first time. The means adopted for dealing with this somewhat difficult subject appear to us well calculated for producing the desired result, and in a manner which even those who consider they have a right to destroy any monuments on their own property, cannot but regard as equitable.

The conservation of monuments such as barrows, dolmens, menhirs, earthworks, stone-circles, &c., is placed by the Bill under the charge of a body of Commissioners, consisting of the Inclosure Commissioners, the Master of the Rolls, the Presidents of the Societies of Antiquaries of London and of Scotland, the Keeper of the British Antiquities at the British Museum, and three other Commissioners to be nominated by the Crown. Under their charge are placed certain monuments specified in a Schedule attached to the Bill; but, with the consent of the Treasury, other monuments of a similar kind may, at any future time, be brought under their control. When once this has been done, any injury or damage to the monuments will be treated as a malicious injury and become penal, unless the written permission of the Commissioners has been obtained, or they have declined to purchase either the monument itself, or a power to restrain the owner or occupier of it from injuring it during a certain period of years.

Powers are given to the Commissioners to purchase the freehold, or other estate, in any monument and rights of way for the public to it, as well as to exercise the power of restraint from injury. The amount of compensation to be awarded under either head is to be determined under the provisions of an already existing Act of Parliament; but in all cases the consent of the Treasury will be necessary before there can be any outlay of public money.

These are the main provisions of the Bill, but the necessary clauses with regard to notices, powers of access, conservation of monuments, and other matters, have not been omitted, and have evidently been carefully considered. The Schedule attached to the Bill is at present apparently undergoing revision, but about eighty of the principal prehistoric monuments of the United Kingdom are already specified.

It appears to us that it would be wise for the local societies in our different counties to furnish Sir John Lubbock with catalogues of the principal monuments in their respective districts, such as in their opinion ought to be placed under the protection of the Commissioners, so as to make the list as complete in the first instance as possible, and avoid the necessity of making continual additions to it.

The mere fact of a barrow, dolmen, or camp, being thought of sufficient importance to be cited by name in an Act of Parliament would tend to raise it in the respect of the inhabitants of the surrounding country and in most cases suffice to preserve it from wanton injury. The general spread of education will also do much to encourage a regard for our national antiquities, of which, notwithstanding neglect in the past, we have still a fair number to show. Let us do what we can to preserve them ere it be too late, and not let posterity charge the present generation with neglect, should at some future time a greater interest arise in these relics of a dim past, and it then be found that of monuments now extant all that can be said will be "Etiam periere ruinæ."

In France it is certainly the case that where a building or other ancient structure is "classé comme monument historique," it is regarded with some degree of pride and affection by those who live near it, and the necessary expenses for the preservation of such monuments do not appear to be grudged.

In this country, also, what small expense the Treasury might incur in the defence and preservation of our national monuments would, we are sure, be cheerfully met; but we are inclined to think that it will only be in rare and exceptional cases that any outlay whatever, beyond, perhaps, the expense of a few notices, will be necessary.

Among the multitude of private Bills brought in at the commencement of a Session, it is not always that the doctrine of the "survival of the fittest" applies. In this instance, however, we trust that the Bill will be exposed to neither neglect nor mishap. It is supported by members on both sides of the House; it does not appeal to Party, but to the patriotism of the whole nation, and it is brought in under the auspices of a member whose reputation as an archæologist, though great throughout the country, is exceeded by his popularity as the author of the most successful measure of private legislation in modern times—the Bank Holiday Act.

HERBERT SPENCER'S PSYCHOLOGY

The Principles of Psychology. By Herbert Spencer. Second Edition. (London: Williams and Norgate.)

I.

To give readers some idea of the contents of a good book is very often the most useful thing a reviewer can do. Unfortunately that course is not open to us in the present instance. The subject is too vast. We cannot exhibit the grandeur; we can only in a few general phrases express our admiration of the profound, all-embracing philosophy of which the work before us is an instalment. The doctrine of evolution when taken up by Mr. Spencer was little more than a crotchet. He has made it the idea of the age. In its presence other systems of philosophy are hushed, they cease their strife and become its servants, while all the sciences do it homage. The place that the doctrine of evolution has secured in the minds of those who think for the educated public may be indicated by a few names taken just as they occur. Mr. Darwin's works, the novels of George Eliot, Mr. Tylor's "Primitive Culture," Dr. Bastian's "Beginnings of Life," and Mr. Bagehot's "Physics and Politics," have almost nothing in common but the idea of evolution, with which they are all more or less imbued. In a word we have but one other thinker with whom in point of influence on the higher thought of this, and probably of several succeeding generations, Mr. Spencer can be classed:—it does not need saying that that other is Mr. J. S. Mill.

As we cannot present such an outline of Mr. Spencer's system of psychology as would make it generally intelligible, the purpose of directing attention to the work will perhaps be best served by selecting as the subject of remark one or two points to which the presence of the controversial element may lend a special interest. After pointing out that the cardinal fact brought to light when nervous action is looked at entirely from the objective point of view, is, that the amount and heterogeneity of motion exhibited by the various living creatures, are greater or less in proportion to the development of the nervous system, Mr. Spencer comes to the vexed question of the relation between nervous phenomena and phenomena of consciousness. This is a subject about which in its more subtle aspects there is much uncertainty and some confusion of thought. It may be taken as established that every mode of consciousness is a concomitant of some nervous change. Given certain physical conditions accompanied by a special state of consciousness, and there is every reason to believe that physical conditions in every respect identical, will always be attended by a similar state of consciousness. This, and not more than this, we think, was intended by Mr. Spencer in his chapter on Æstho-physiology. Nevertheless, several able men have, it would appear, been led to suppose that he countenances a kind of materialism (not using the word to imply anything objectionable, for why not be materialists, if materialism be truth?), which forms no part of his philosophy. To give precision and emphasis to what we say, we would take the liberty to refer to the position taken up by Dr. Bastian in his remarkably able and important work on the "Beginnings of Life." The expression that definitely raises the issue of which we wish to speak, and which at the same time fixes Dr. Bastian to a view not in harmony with the teaching of Mr. Spencer, is the following:—"We have not yet been able to show that there is evolved, during brain action, an amount of heat, or other mode of physical energy, less than there would have been had not the Sensations been felt and the Thoughts thought;" but he believes that this is the case. Our present object is not so much to show that here speculation has got on a wrong track, as that, if we understand Mr. Spencer, it is not his opinion that anything of this kind takes place; though certainly some ambiguous phrases might be held to convey this meaning. We have mentioned the significant fact that the size of the nervous system holds a pretty constant relation to the amount and heterogeneity of motion generated. The implication is that none of the motion evolved during nervous action disappears from the object world, passes into consciousness in the same sense that physicists speak of momentum passing into heat; that whether consciousness arise or not, there will be for the molecular motion set up in the nerve substance, exactly the same mechanical equivalents. Whether, for example, those ganglia that in the body of each one of us are employed in carrying on what we call reflex action, are so many distinct seats of consciousness, like so many separate animals, an idea for which much has been said, or whether the nerve-changes that go on in these ganglia have no subjective side; in either case the objective facts will remain the same. If consciousness is evolved, it is not at the expense of a single oscillation of a molecule disappearing from the object world. No doubt it is hard to conceive consciousness arising in this apparently self-created way; but if any suppose that by using phrases that would assimilate mind to motion they ease the difficulty, they but delude themselves. It is as easy to think of consciousness arising out of nothing, if they will, as to conceive it as manufactured out of motion; that is to say, the one and the other proposition are alike absolutely unthinkable. On this point Mr. Spencer writes, "Can we think of the subjective and objective activities as the same? Can the oscillations of a molecule be presented in consciousness side by side with a nervous shock, and the two be recognised as one? No effort enables us to assimilate them. That a unit of feeling has nothing in common with a unit of motion, becomes more than ever manifest when we bring the two into juxtaposition." Mr. Spencer's idea is that feeling and nervous action are two faces of the same ontological something,—a view that prohibits the notion of the one passing into or being expended in producing the other. The conclusion is that the transformations of physical energy remain unaffected by the presence or absence of consciousness.

Psychology has as yet been made a serious study by only a few individuals. Accordingly it is only the more striking and easily grasped peculiarities of Mr. Spencer's system that can be referred to with advantage. Of these the most imposing, and the one of which the educated public have already a slight second-hand acquaintance, is the doctrine that the brain and nervous system is an organised register of the experiences of past generations, that consequently the intelligence and character of individuals and of races depend much more on this, on the experiences of their ancestors, than on their individual experiences. The flood of light thrown by this conception on so many things previously dark and unfathomable, its power of bringing about harmony where before there was nothing but confusion and unsatisfactory wrangling, ought to have been sufficient to have secured it a universally favourable reception. This, however, has not been the case, and partly, perhaps, because of the very merits that recommend it. It may be that veterans who have won their laurels on, say, the battle-field of innate ideas, love the old controversy, and are not anxious to learn that both sides were right and both wrong. Moreover, it is the misfortune of this important addition to psychology, that it shows that previous workers in this field of inquiry nave at times been labouring in the dark to solve problems like in kind with the famous difficulty of accounting for the supposed fact, that the weight of a vessel of water is not increased by the addition of a live fish. For instance, should Mr. Spencer be right, the celebrated theory of the Will, elaborated by Prof. Bain, the able representative of the individual-experience psychology, becomes a highly ingenious account of what does not happen. Thus, the new doctrine can be accepted only at the expense of giving up much of what has hitherto passed for mental science.

The following sentences will serve to indicate Mr. Spencer's position: "The ability to co-ordinate impressions, and to perform the appropriate actions, always implies the pre-existence of certain nerves arranged in a certain way. What is the meaning of the human brain? It is that the many *established* relations among its parts stand for so many *established* relations among the psychical changes. Each of the constant connections among the fibres of the cerebral masses, answers to some constant connection of phenomena in the experiences of the race." "Those who contend that knowledge results wholly from the experiences of the individual, ignoring as they do the mental evolution which accompanies the autogenous development of the nervous system, fall into an error as great as if they were to ascribe all bodily growth and structure to exercise, forgetting the innate tendency to assume the adult form." "The doctrine that all the desires, all the sentiments, are generated by the experiences of the individual, is so glaringly at variance with facts, that I cannot but wonder how anyone should ever have entertained it." The circumstances which account for the existence of the individual-experience psychology, and which enable it still to hold out as a rival of the more advanced form that Mr. Spencer has given to the science are these: (1) the immaturity of the human infant at birth; (2) the lack of precise knowledge with regard to the mental peculiarities of the lower animals; (3) the still popular notion that the human mind does not resemble the mental constitution of the animals, that it is of a different order. Of course this last is now-a-days little more than a popular superstition, nevertheless it can be taken advantage of; and an argument to the effect that the mental operations of the animals are, to all appearance, so very different from the workings of the human mind, that they can supply nothing more than a worthless, if not a misleading analogy, has a very specious and scientific look about it, in the eyes of those who are not very well acquainted with the subject. Our ignorance of animal psychology may be still more boldly drawn on in defence of the theory under consideration. With a hyper-scientific caution, its advocates refuse to take into account anything (incompatible with their theory) concerning any one species of animal that has not been proved by a very overwhelmingly large number of very accurate observations. And they find it possible to maintain that it still remains unproved that any species of animal possesses either knowledge or skill not wholly acquired by each individual. A better acquaintance with the mental peculiarities of the animals is certainly a desideratum, and we hope that this rich field of investigation will not long remain uncultivated. In *Macmillan's Magazine* for this month there is an account of a series of observations and experiments on young animals by the present writer, which, unless they can be discredited, may reasonably be expected to go far to establish the fact of instinct, the fact of innate knowledge and unacquired skill; in other words, the phenomena on which the experience-psychology, minus the doctrine of inheritance, can throw no light whatever. Now, had not Mr. Darwin banished from every scientific mind the hypothesis of the miraculous creation of each distinct species of animal just as we see it, with all its strange organs and, to most people, still stranger instincts, the presumption against a system of human psychology that not only can give no account of the most striking phenomena in the mental life of the animals, but which strongly inclines those who hold it to pronounce such phenomena incredible, might not have been so apparent. But in the present state of our scientific knowledge, such a psychology, professing to be a complete system, is self-condemned. In its fundamental principles the science of mind must be the same for all living creatures. Further, if man be, as is now believed, but the highest, the last, the most complex product of evolution, a system professing to be an analysis and exposition of his mind, yet confessing itself incompetent to deal with the necessarily simpler mental processes of lower creatures, must surely feel itself in an uncomfortably anomalous position.

It is, however, on the first-mentioned circumstance, the immaturity of the infant at birth, that most stress can be laid. The newly-born babe cannot raise its hand to its mouth, and doubtless for a long time after birth it has no consciousness of the axiom "things that are equal to the same thing are equal to one another." The helplessness of infancy is pointed to as furnishing ocular demonstration of the doctrine that, whatever may be the case with the animals, all human knowledge, all human ability to perform useful actions, must be wholly the result of associations formed in the life-history of each individual. But it can surely require little argument to show that this is an entirely unwarranted assumption. It might as well be maintained that because a child is born without teeth and without hair, the subsequent appearance of these must be referred wholly to the operation of external forces. Of the several lines of argument that might here be employed, let us, for the sake of freshness, take the analogy from the lower animals. We are not aware that it can be asserted as the result of prearranged and careful observations, that any creature at the instant of birth exhibits any of the higher instincts. A number of isolated and more or less accidental observations have been recorded; and apparently on the strength of these Mr. Spencer has made the following unqualified statement:—"A chick, immediately it comes out of the egg, not only balances itself and runs about, but picks up fragments of food, thus showing us that it can adjust its muscular movements in a way appropriate for grasping an object in a position that is accurately perceived." The fact is, that on emerging from the shell, the chick can no more do anything of all this than can the new-born child run about and gather blackberries. But between the two there is this great difference, that whereas the chick can pick about perfectly in less than twenty-four hours, the child is not similarly master of its movements in as many months. Our present point is, that it can be shown by experiment that the performances of the chick a day old, which involve the perceptions of distance and direction by the eye and the ear, and of many other qualities of external things, are not in any degree the results of its individual experiences. Let it now be remembered that, in the absence of conclusive evidence to the contrary, it has been considered a safe position to hold that the early knowledge and intelligent action of the chicken "may be, after all, nothing more than very rapid acquisitions, the result of that experimentation, prompted by the inborn or spontaneous activity." May we now, on the other side, similarly presume, until the contrary is shown, that the more tardy progress of the infant is not because its mental constitution has to be built up from the foundation out of the primitive elements of consciousness, which the chicken's has not, but rather because the child comes into the world in a state of greater physical, and therefore mental immaturity? The progress of the infant, however, has been so continually spoken of as if it were a visible process of unaided acquisition, that it may give some surprise when it is asserted from the other side that we have no sufficiently accurate acquaintance with the alleged acquisitions of infancy to justify the doctrine that they are different in kind from the unfolding of the inherited instincts of the chicken. To give definiteness to the attitude taken up, we would say, for example, that the facts concerning the early movements of the two lambs and the calf observed by Prof. Bain, and which, looked at from his point of view, were strong confirmation of the doctrine of individual acquisition, may be just as readily interpreted as the unfolding of inherited powers; which, as far as we know, start into perfect action at the moment of birth, in no single instance. From observations on several newly-dropped calves, the facts corresponding substantially with those recorded by Prof. Bain, the present writer could draw no conclusive evidence in favour of either the one theory or the other. One observation, however, may here be mentioned that seemed rather to favour the doctrine of inheritance. A calf one hour old, which had been staggering about on its legs for ten minutes, stepped out at the open door of the byre. It no sooner found itself in the open air, than it began to frisk and dance; it was left entirely to itself, and when it had been on its legs fifteen minutes, it—apparently in obedience to the feeling of fatigue—deliberately lay down, folding in its limbs after the established manner of its kind. This is all we know about calves; about children we know nothing at all. And it may fairly be asked how, when called in question, the assumption that underlies such statements as the following can be made good. We quote from Prof. Bain's account of the growth of voluntary power. He says:—"The infant is unable to masticate; a morsel put into its mouth at first usually tumbles out. But if there occur spontaneous movements of the tongue, mouth, or jaw, giving birth to a strong relish, these movements are sustained, and begin to be associated with the sensations; so that after a time there grows up a firm connection.' Bearing in mind that when born the child has no occasion for the power of masticating solid food; that the ability to suck, which involves an equally complex series of muscular adjustments, is what it requires, and this it has by instinct; bearing all this in mind, the question is, why may not the innate ability to masticate be developed by the time it is required quite as spontaneously as the teeth used in the operation? Take a parallel. The feeble nestling when it leaves the shell is blind. One of the several very pronounced and interesting instincts it exhibits at this stage is, that in response to certain sounds it opens its mouth and struggles to hold up its head to be fed. Several weeks later it begins to pick for itself. Now we put the question, is this second mode of filling its stomach to be considered a pure acquisition, while its original plan must certainly be regarded as pure instinct? No one, we think, will venture to answer in the affirmative; the more so as this is a case that may any day be put to the test of experiment. Where, then, is the evidence that the analogous progress from drawing milk to masticating solid food is of a different kind?

DOUGLAS A. SPALDING

OUR BOOK SHELF

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Zweites Heft: (Breslau, 1872.)

THIS part contains the following memoirs:—Dr. Ciesielski, "Investigations on the downward Curvature of the Root." Dr. Frank "On the position and direction of floating and submersed parts of plants." Dr. Cohn "On Parasitic Algæ." Dr. Schroeter "On certain Pigments formed by the Bacteriæ," and Dr. Cohn's "Investigations on Bacteriæ."

This work—Cohn's "Beiträge zur Biologie der Pflanzen"—is the organ more especially of the workers in the phyto-physiological laboratory at Breslau, under the guidance of the eminent Professor of Botany in the University there. The first part appeared in 1870 (NATURE, vol. iii. p. 242).

Dr. Ciesielski's researches follow up the interesting inquiries into the same subject opened a few years ago by Prof. Hofmeister and others. He sums up with the following propositions :—

1. The normal growth of germinating seedlings may be observed in a saturated atmosphere, if the albumen or cotyledons be kept constantly moist, without the root descending into either water or moist earth. The development of the root ceases however as soon as the reserve of nutrient matter in the seed is exhausted.

2. The longitudinal extension of the root takes place exclusively in a relatively narrow region behind the tip.

3. The downward curvature of the root takes place at that point where the longitudinal growth of its cells is at a maximum.

4. Gravitation occasions the downward curvature.

5. This curvature is not passive but active; that is to say, gravitation occasions in the root a tension of the tissue whenever it departs from its normal direction, and thus determines downward curvature.

6. This tension is due to the more considerable growth of those cells which lie on the side of the root turned towards the zenith.

7. The more marked growth of the cells of this side of the root is occasioned by the circumstance that the cell-contents of the upper side turned towards the zenith are much less concentrated than in the under side; which, again, is due to the action of gravity which determines that the more concentrated cell-sap, being the heavier, shall occupy the under side of the root.

8. If the outermost tip (*Vegetationskegel*) of a root be cut off, it may indeed elongate through mere extension of its tissues, but it is no more capable of downward curvature.

9. If however it afterwards developes a new formative apex, as occasionally happens, and so elongates at the cut apex, the root again becomes capable of downward curvature.

10. Centrifugal force determines in a similar manner and on analogous ground, the curvature of the root in the direction of this force, as does gravitation in that towards the nadir.

The next thing will be to explain the relation of *ascending* axes to gravitation. It would seem as though heliotropismus and geotropismus had squabbled over the embryo and compromised matters at last by each taking a *Vegetationskegel*, one of the plumule the other of the radicle, with its active future control!

Dr. Frank's paper is an inquiry into the causes which influence the position and direction of the floating and submersed leaves of aquatic plants apart from the direct operation of gravity and sunlight, which are not causes directly productive of special modifications of growth, but rather guides according to which the organ in the course of growth adjusts itself so far as it is able, until it has attained a position the most advantageous to it.

Prof. Cohn's memoir touches upon the question, of peculiar interest just now, of the relation of the lower forms of vegetable life destitute of chlorophyll to the organic matter in which they find their matrix and to the inorganic world, with regard to their power of assimilating independently their necessary nutriment and reducing carbonic acid. He also carefully describes as a new unicellular genus of truly parasitic algæ, *Chlorochytrium* (allied to *Hydrocytium* and the *Chytridineæ*) which he finds inhabiting the fronds of *Lemna trisulca*. The occurrence of this chlorophyll—containing alga in *Lemna*, he regards as presenting an analogy with the presence of the green gonidial layer in lichens, which he looks upon similarly as an endophytal alga.

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 Janssen-Lockyer Application of the Spectroscope

I SEE by a letter in the *English Mechanic and World of Science* of January 31, that Mr. R. A. Proctor claims for Dr. Huggins the credit of having publicly described in Feb. 1868, the method of viewing the solar protuberances without a total eclipse.

Permit me to state that to Mr. Lockyer undoubtedly belongs the credit of having known this method even before his preliminary paper in 1866 in which it was sufficiently published. We had numerous conversations on the subject, and when he showed me the MS. of his preliminary paper and told me at the same time that he was about to ask a grant for the purpose of procuring a more powerful spectroscope, I advised him to introduce his views in the shape of a question, which he accordingly did in the following terms :—"May not the spectroscope afford us evidence of the existence of the 'red flames' which total eclipses have revealed to us in the sun's atmosphere, although they escape all other methods of observation at other times? and if so may we not learn something from this of the recent outburst of the star in Corona?"

I gave this advice to my friend, Mr. Lockyer, because I thought that as it might be some time before he obtained the new instrument it might be well that he should publish what I conceived would enable him to claim for himself the knowledge of this principle. And I think that anyone well acquainted with spectra on reading the question put, could not fail to see what was meant, and if he were previously ignorant of the principle, he could not fail to perceive it. I therefore feel rather astonished that anyone should claim the statement made by Huggins two years afterwards as being the commencement of a new principle. The method founded upon this principle was first successfully applied by Messrs. Janssen and Lockyer, acting independently of each other, in the year 1868. Mr. Lockyer had by this time obtained his improved spectroscope, and the very first day he used it he made the discovery. I do not think there is any reason to suppose that Mr. Lockyer was at all aided, as was suggested by Mr. Huggins, in detecting these lines by the somewhat vague information of what had been done at the total eclipse in India. He was now provided with an instrument capable of showing these lines to a child—made in fact for the purpose of showing them. Now what would have been thought of any one of the Indian observers if during the few minutes of a total eclipse he had failed to detect the existence of bright lines? Can we imagine therefore that an intelligent observer like Mr. Lockyer, with an instrument constructed for the purpose and with unlimited time at his disposal, should have failed in detecting such lines even had he not previously been sure that they existed? I confess I cannot understand any observer failing in a thing of this nature, and therefore I do not know well how to account for the somewhat puzzling remark made by Dr. Huggins in his notes to Schellen's "Spectrum Analysis" as follows :—

"Though to Mr. Lockyer is due the first publication of the idea of the possibility of applying the spectroscope to observe the red flames in sunshine, as a matter of history it should not be passed over that, about the same time, the same idea occurred quite independently to two other astronomers, Mr. Stone of Greenwich, and Mr. Huggins. These observers were however unsuccessful in numerous attempts which they made to see the spectra of the prominences, for the reason probably that the spectroscope which they employed was not of sufficient dispersive power to make the bright lines of the solar flame easily visible. When the position of the lines was known, Huggins saw them instantly with the same spectroscope (two prisms of 60°), which he had previously used in vain."

I confess I cannot yet understand why a distinguished observer like Dr. Huggins, possessing such an instrument as he did, should fail to have seen the bright lines at first, nor why, believing as he did in the aid afforded by the Indian observations to an observer searching for these lines, he should yet have left it to Mr. Lockyer to make this discovery.

BALFOUR STEWART

Dr. Bastian's Experiments on the Beginning of Life

IN the issue of NATURE for January 9, Dr. Burdon Sanderson has recorded some experiments on the behaviour of certain organic mixtures boiled for five or ten minutes in flasks which were hermetically sealed during ebullition. He found, as Dr. Bastian had done, that Bacteria appeared in these sealed vessels —not always, but frequently. Dr. Sanderson is, however, careful not to endorse the conclusions which Dr. Bastian has drawn from these experiments. This method of experimenting appears to me to involve two serious sources of error which invalidate them in so far as they are used to support the theory of spontaneous generation.

The first source of error is the possibility of the introduction of atmospheric germs at the moment of sealing.

Those who are practised in the sealing of flasks during ebullition are aware that the sealing can only take place just as ebullition is about to cease; otherwise the vessel bursts, or the imprisoned steam opens a path for itself through the softened glass where the flame is being applied. There is thus at the moment of sealing, a risk of some reflux of air into the flask and a consequent vitiating of the experiment. Perhaps it may be thought that because air thus introduced has to pass through the flame applied to the tube through the red-hot tube itself, and enters a flask whose contents are not far below the boiling temperature, any germs contained in it must be destroyed; but that is a very hazardous assumption. *Momentary* contact (or approximate contact) with a flame or a heated surface is by no means so destructive as at first appears, and experience has taught me to suspect that the contents of a boiling flask are not speedily deprived of vitality. This source of error is probably not a frequent occurrence in Dr. Bastian's experiments, but I am inclined to think that it was a frequent one in Dr. Wyman's experiments, and that it seriously vitiates all those experiments in which air passed through a heated tube was used. At any rate the exactness of experiments so conducted is very much at the mercy of the care and dexterity of the operator, and hence, probably, their contradictory results in different hands.

In repeating Dr. Bastian's experiments I have avoided this source of error by inserting a tight plug of cotton wool in the neck of the flask before beginning to boil. In this way any chance germs introduced by an accidental reflux of air during sealing are prevented from passing into the flask.

The second source of error is much more important. It is this:—*Dr Bastian's process does not insure that the entire contents of the flask are effectively exposed to the boiling heat.* Herein lies, I believe, the chief cause of the inconstant and contradictory results obtained by him. It is beyond doubt that Dr. Bastian is perfectly correct in his statement that the experiments made by Pasteur with "Pasteur's solution," and by Lister with urine, yield different results when made with other solutions and mixtures. The contrast is most striking. In my own experiments I have found that filtered infusions of any animal or vegetable substances (and I have tried a very great variety) can be invariably preserved unchanged when boiled for five or ten minutes in a flask plugged with cotton wool; but if milk be treated in the same way, or if a few fragments of a green vegetable be added to the infusion, or if alkaline albuminous solutions or mixtures, containing cheese, be treated in the same way, they almost invariably breed Bacteria in abundance. What is the cause of this difference? For some time it appeared to me difficult to account for, but I came to the conclusion at length that it was simply due to the fact, that with the more complex organic mixtures every particle of the material within the flask does not really attain the boiling heat. These more complex mixtures generally froth excessively in boiling, and spurt about particles which adhere to the glass, and probably some of these escape the full effect of the heat. What first led me to this conclusion was the behaviour of milk. Milk boiled for ten or even twenty or thirty minutes, in a plugged flask, almost invariably curdled and produced Bacteria in a few days; but when the milk was put into a long-necked flask, plugged with cotton wool, and hermetically sealed, and the flask boiled in a good-sized can of water for twenty or thirty minutes, then the milk remained permanently unchanged, and produced no Bacteria. I possess specimens of milk treated in this way which have remained unchanged for many months, though exposed to warmth, to light, and free access of air, that is to say, to air filtered through a good plug of cotton wool. I obtained similar results with the other organic mixtures which could not be kept unchanged by simple boiling over the flame. Highly putrescent mixtures, containing blood-serum, egg-albumen, fragments of meat and vegetables, remained perfectly barren after the flask containing them had been immersed in a water-bath kept at a boiling heat for twenty or thirty minutes.

The essential conditions of the experiment are, first, the effective exposure of the whole contents of the flask to a boiling heat; secondly, the absolute prevention of any fresh entrance of extraneous solid or liquid particles; and the conclusion I have come to is that if these conditions are rigidly observed, the flasks remain barren; if they do not remain barren it is simply because one or other of these conditions has not been observed.

Manchester WM. ROBERTS

The unreasonable

I UNRESERVEDLY accept Prof. Clifford's disavowal of the meaning I attributed to his words concerning Kant's Antinomies, in his Address (*Macmillan's Magazine*, Oct. 1872). At the same time I cannot allow that the misprision was wholly due to my "exuberant imagination." He said, "The opinion is set forth by Kant . . in the form of his famous doctrine of the antinomies," &c. This ought to mean that the "doctrine of the antinomies" is one form of that "opinion;" and the opinion being, "that at the basis of the natural order there is something which we can know to be *unreasonable*," I was fully justified by the mere words of the Address in the inference (which he disclaims) that he intended to identify the doctrine of the antinomies (the Antithetic, in fact) with that of the unreasonable basis of the natural order. How was I to know that the "something" was either (? which) "the transcendental object" or the world of *noumena*?

I premise, then, that it is the Antithetic which "is set forth by Kant in his famous [but little understood] doctrine of the Antinomies," and *not* "the opinion that at the basis of the natural order there is something which we can know to be unreasonable." Prof. Clifford, however, meant to signalise the latter; and he asserts, and by sundry extracts from the *K. r. V.* attempts to substantiate the assertion, that "the transcendental object [which lies at the basis of the natural order] is *unreasonable*, or evades the processes of human thought."

Now Kant, so far from proving (or asserting) *that*, takes pains to show that it is *reasonable*, though it persistently seems to be the reverse! According to Kant, the thing *per se* illusorily appears to be the object of experience; and this illusion is inevitable, and no criticism can dispel it. (Kant compares it to the seeming magnitude of the horizontal moon.) But criticism can and does explain it, so that, though it persists as a spectre haunting the reason, it is wholly and strictly amenable to the processes of reason, or in Prof. Clifford's sense, *reasonable*.

Of Prof. Clifford's quotations, (*a*) and (*b*) are irrelevant to his second position; the former does not directly touch "the processes of human *thought*;" the latter does not touch "the transcendental object!" His third position is equally unsupported by the extract, "Man [*not* Mann] kann aber," &c., which may be thus rendered:—"But conversely we can also deduce from this antinomy a real, not indeed a dogmatical, but a critical and doctrinal advantage, namely, of indirectly showing the transcendental ideality of phenomena (*Erscheinungen*)." The method is by showing that the antithesis is contrary, as distinguished from contradictory, and by invalidating both the alternatives, whence it follows that the subject of them is not an existing totality. The antinomies are thus used, not as Prof. Clifford vainly imagines, to prove that the transcendental object is unreasonable, but that the postulate of its being a *noumenon*, or thing *per se*, or true basis of the natural order, is untrue, both alternatives being false.

Prof. Clifford is, as I said, really attacking Hamilton. I do not care where he got the doctrine from, nor what he does with it. If it amuses him to set up these absurd nine-pins and then bowl them over, with flourish of trumpets, I have no wish to interfere with him, only he had better mind his H's and K's, and not impute this stuff to Kant. Once for all: in Hamilton's system the opposed propositions, which do show their subject to be unreasonable, are intended to do duty as contradictories. But in Kant's system the opposed propositions in an antinomy are only seeming contradictories, are virtually contraries, and their common subject remains the subject of an intelligible proposition, and one that Kant believes himself to have substantiated, after the contraries are invalidated: so that the subject is after all amenable to the processes of human thought, though not representing an object of experience. I dare not further trespass on the columns of NATURE to comment upon Prof. Clifford's views of the two legs of Kant's philosophy! Certainly the one leg is wholly due to my opponent's "exuberant imagination:" it is Hamilton's leg, not Kant's.

Athenæum Club, Feb. 17 C. M. INGLEBY

Inherited Feeling

THE remarkable case of an inherited feeling of dislike for a special class of persons, communicated by Mr. Darwin, appears to me to support a view I have long held (but not yet published) as to the explanation of another class of so-called instincts. The three separate instances given in which the dogs showed a violent antipathy to butchers, either without seeing them or when they were dressed as gentlemen, clearly indicates that it was through the sense of smell that the painful sensation was experienced; and this is quite in accordance with the wonderful delicacy and importance of this sense in most animals, and especially in dogs. It is natural to suppose that some ancestor of these dogs was systematically and cruelly ill-treated by several butchers, perhaps from some thievish propensity or other bad habit which required frequent punishment, so that the smell of a butcher came to be invariably associated with pain and a desire for revenge. But the most important fact to observe is, that there must be some peculiar odour developed in human beings by constant contact with flesh, which a dog can recognise apart from individual peculiarities and in spite of perfect disguise. Now the power many animals possess to find their way back over a road they have travelled blindfolded (shut up in a basket inside a coach for example) has generally been considered to be an undoubted case of true instinct. But it seems to me that an animal so circumstanced will have its attention necessarily active, owing to its desire to get out of its confinement, and that by means of its most acute and only available sense it will take note of the successive odours of the way, which will leave on its mind a series of images as distinct and prominent as those we should receive by the sense of sight. The recurrence of these odours in their proper inverse order—every house, ditch, field, and village having its own well-marked individuality—would make it an easy matter for the animal in question to follow the identical route back, however many turnings and cross-roads it may have followed. This explanation appears to me to cover almost all the well-authenticated cases of this kind.

ALFRED R. WALLACE

I AM able to corroborate the remarkable fact mentioned in Dr. Huggins's letter in your last.

My father possessed a mastiff, a son of Sybil, daughter of Turk, who has, ever since he was a pup, evinced the same antipathy to butchers. We have hitherto been unable to explain it, for he is always perfectly good tempered with other tradesmen who come to the house. The butchers have, on several occasions, tried to propitiate him by throwing him presents of meat, but although willingly enough received, it has done nothing towards abating his hostility. H. G. BROOKE

Hale Carr, Altrincham, Feb. 15

I HAVE a cat, of a long-haired breed, whose aversion to dogs is unusually strong. Last autumn, six kittens of hers, under two days old, were in a corner of the kitchen where they had had no opportunity of making acquaintance with any dog; yet, on being stroked (in their mother's absence) by a hand which a dog had just licked, more than one of them "swore" violently. This was repeated several times, but the little creatures showed no dislike to being touched with a clean hand.

A LOVER OF ANIMALS

Two or three months ago I was walking with my two little girls near the railway bridge at West Kensington, when the children (who always find the attraction of a fine dog irresistible) made me stop to admire a tall and remarkably handsome mastiff, apparently the property of a man who stood by with a hand-barrow. He was speaking to two other men of this dog, and of another of the same kind which he had at home, and telling them that they were quiet and amiable to all men but butchers, and that it was not safe for a butcher to come near either of them. One of the men said that he believed all dogs of that breed showed the same antipathy; and added that when they were left loose at night to guard premises, they would always allow a policeman to enter.

This chance conversation is perhaps hardly worth troubling you with, as I have no means of ascertaining whether these dogs claimed kindred with Turk, but I send it to you, nevertheless.

M.

Kensington Square, Feb. 17

EFFECT OF LIGHT ON SELENIUM DURING THE PASSAGE OF AN ELECTRIC CURRENT*

BEING desirous of obtaining a more suitable high resistance for use at the Shore Station in connection with my system of testing and signalling during the submersion of long submarine cables, I was induced to experiment with bars of selenium, a known metal of very high resistance. I obtained several bars varying in length from 5 to 10 centimetres, and of a diameter from 1 to $1\frac{1}{2}$ millimetres. Each bar was hermetically sealed in a glass tube, and a platinum wire projected from each end for the purpose of connection.

The early experiments did not place the selenium in a very favourable light for the purpose required, for although the resistance was all that could be desired—some of the bars giving 1,400 megs. absolute—yet there was a great discrepancy in the tests, and seldom did different operators obtain the same result. While investigating the cause of such great differences in the resistance of the bars, it was found that the resistance altered materially according to the intensity of light to which it was subjected. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained very constant, fulfilling all the conditions necessary to my requirements; but immediately the cover of the box was removed, the conductivity increased from 15 to 100 per cent. according to the intensity of the light falling on the bar. Merely intercepting the light by passing the hand before an ordinary gas-burner placed several feet from the bar increased the resistance from 15 to 20 per cent. If the light be intercepted by rock salt or by glass of various colours, the resistance varies according to the amount of light passing through the glass.

To ensure that temperature was in no way affecting the experiments, one of the bars was placed in a trough of water so that there was about an inch of water for the light to pass through, but the results were the same; and when a strong light from the ignition of a narrow band of magnesium was held about nine inches above the water the resistance immediately fell more than two-thirds, returning to its normal condition immediately the light was extinguished.

* Communicated to the Society of Telegraph Engineers, February 12, by Mr. Latimer Clark, from Mr. Willoughby Smith, Electrician to the Telegraph Construction Company

PARTING BANQUET TO PROF. TYNDALL

ON the evening of February 4 Prof. Tyndall's visit to the United States was crowned by a banquet at Delmonico's, New York, at which there were present about 200 of the most distinguished citizens of the country, presided over by the Hon. William M. Evarts. Among the company present were the following: The Rev. Dr. Bellows, Parke Godwin, Dr. Draper, A. M.

Mayer, Rev. Henry Ward Beecher, President F A. P. Barnard, Rev. Dr. Hitchcock, Rev. Dr. H. C. Potter, Dr. A. Flint, Dr. Hammond, Rev. Dr. Osgood, A. Appleton, G. S. Appleton, Judge Brady, Dr. H. Draper, V Botta, J. C. Draper, Judge Daly, the Hon. E. D. Morgan, B. Silliman, Prof. G. F. Barker, of Yale College, Gen. Franklin, D. Van Nostrand, H. S. Kendrick, Prof. Chandler, Prof. S. F. Baird, of the Smithsonian Institute, Prof Michie, Prof. Pompelly, E. L. Godkin, Fred. Law Olmsted, Prof. W. H. Chandler, of Columbia College, Sterry Hunt, C. W. Field, Gen. Myers, E. L. Youmans, A. S. Hewitt, Wilson G. Hunt, Dr. Sims, Col. Dwight, J. B. Scribner, W. H. Appleton.

There were several very happy after-dinner speeches, by men of various professions and opinions. We present our readers with a few extracts from the speech of Prof. Tyndall.

Referring to the interest shown in his lectures, he said :—" Every such display of public sympathy must have its prelude, during which men's minds are prepared, a desire for knowledge created, an intelligent curiosity aroused. Then in the nick of time comes a person who, though but an accident, touches a spring which permits tendency to flow into fact, and public feeling to pass from the potential to the actual. The interest displayed has really been the work of years, and the chief merit rests with those who were wise enough to discern that, as regards physics, the detent might be removed, and the public sympathy for that department of science permitted to show itself. Among the foremost of those who saw this must be reckoned my indefatigable friend Prof. Youmans. In no other way can I account for my four months' experience in the United States. To no other country is the cultivation of science in its highest forms of more importance than to yours. In no other country would it exert a more benign and elevating influence. What, then, is to be done toward so desirable a consummation ? Here I think you must take counsel of your leading scientific men, and they are not unlikely to recommend something of this kind. I think, as regards physical science, they are likely to assure you that it is not what I may call the statical element of buildings that you require so much as the dynamical element of brains. Making use as far as possible of existing institutions, let chairs be founded, sufficiently but not luxuriously endowed, which shall have original research for their main object and ambition. With such vital centres among you, all your establishments of education would feel their influence ; without such centres even your primary instruction will never flourish as it ought. I would not, as a general rule, wholly sever tuition from investigation, but, as in the institution to which I belong, the one ought to be made subservient to the other. The Royal Institution gives lectures—indeed it lives in part by lectures, though mainly by the contributions of its members, and the bequests of its friends. But the main feature of its existence—a feature never lost sight of by its wise and honourable Board of Managers—is that it is a school of research and discovery. And though a by-law gives them the power to do so, for the twenty years during which I have been there no manager or member of the institution has ever interfered with my researches. It is this wise freedom, accompanied by a never-failing sympathy, extended to the great men who preceded me, that has given to the Royal Institution its imperishable renown.

"I have said that I could not wholly sever tuition from investigation, and I should like to add one word to this remark. In your chairs of investigation let such work as that in which I have been lately engaged be reduced to a minimum. Look jealously upon the man who is fond of wandering from his true vocation to appear on public platforms. The practice is absolutely destructive of original work of a high order. Now and then the discoverer, when he has anything important to tell, may appear with benefit to himself and the world. But as a general rule he must leave the work of public lecturing to others. This may appear to you a poor return for the plaudits with which my own efforts have been received ; but these efforts had a special aim. My first duty toward you, moreover, is to be true, and what I say here is the inexorable truth.

"As to the source of the funds necessary for founding the chairs to which I have referred it is not for me to offer an opinion. Without raising the disputed question of State aid, in this country it is possible to do a great deal without it. As I said in my lectures, the willingness of American citizens to throw their fortunes into the cause of public education is without a parallel in my experience. Hitherto their efforts have been directed to the practical side of science, and this is why I sought in my lectures to show the dependence of practice upon principles. On the ground, then, of mere practical, material utility, pure science ought to be cultivated. But assuredly among your men of wealth there are those willing to listen to an appeal on higher grounds, to whom, as American citizens, it will be a pride to fashion American men so as to enable them to take their places among those great ones mentioned in my lectures. Into this plea I would pour all my strength. Not as a servant of Mammon do I ask you to take science to your hearts, but as the strengthener and enlightener of the mind of man.

"Might I now address a word or two to those who in the ardour of youth feel themselves drawn toward science as a vocation. They must, if possible, increase their fidelity to original research, prizing far more than the possession of wealth an honourable standing in science. They must, I think, be prepared at times to suffer a little for the sake of scientific righteousness, not refusing, should occasion demand it, to live low and lie hard to achieve the object of their lives. I do not here urge anything upon others that I should have been unwilling to do myself when young. Let me give you a line of personal history. In 1848, wishing to improve myself in science, I went to the University of Marburg—the same old town in which my great namesake, when even poorer than myself, published his translation of the Bible. I lodged in the plainest manner, in a street which, perhaps, bore an appropriate name while I dwelt upon it. It was called the *Ketzerbach*—the heretic's brook—from a little historic rivulet running through it. I wished to keep myself clean and hardy ; so I purchased a cask and had it cut in two by a carpenter. Half that cask, filled with spring water over night, was placed in my small bedroom, and never during the years that I spent there, in winter or in summer, did the clock of the beautiful Elizabethekirche, which was close at hand, finish striking the hour of six in the morning before I was in my tub. For a good portion of the time I rose an hour and a half earlier than this, working by lamp-light at the differential calculus when the world was slumbering round me. And I risked this breach in my pursuits and this expenditure of time and money, not because I had any definite prospect of material profit in view, but because I thought the cultivation of the intellect important— because, moreover, I loved my work, and entertained the sure and certain hope that, armed with knowledge, one can successfully fight one's way through the world. It is with the view of giving others the chance that I then enjoyed that I propose to devote the surplus of the money which you have so generously poured in upon me, to the education of young philosophers in Germany. I ought not, for their sake, to omit one additional motive by which I was upheld at the time here referred to—that was a sense of duty. Every young man of high aims must, I think, have a spice of this principle within him. There are sure to be hours in his life when his outlook will be dark, his work difficult, and his intellectual future uncertain. Over such periods, when the stimulus of success is absent, he must be carried by his sense of duty. It may not be so quick an incentive as glory, but it is a nobler one, and gives a tone to character which glory cannot impart. That unflinching devotion to work, without which no real eminence in science is now attainable, implies the writing at certain times of the stern resolve upon the student's character: 'I work not because I like to work, but because I ought to work.' In science, however, love and duty are sure to be rendered identical in the end."

THE TROGLODYTES OF THE VEZERE*

I HAVE come to speak to you about the Troglodytes of the Vezère, of that fossil population whose subterranean dwellings we are about to visit.

Their existence dates back to a startling antiquity. We do not know their name; no historian has mentioned them, not a vestige of them had been discovered until the last eight years; and yet they are better known to us, in many respects, than certain nations celebrated in classical history. We know their mode of life, their industry, their arts, and all the details of their existence. Is not this the true history of races, a history far more interesting than that of their battles, their conquests, and even their dynasties? How can we know so much of a people who have left no trace in the memory of man, and whose very existence would have been declared impossible twenty years ago? Are they the creatures of a dream, like the celebrated Troglodytes of Montesquieu? No. Nothing is more real than our Troglodytes; nothing more authentic than their annals. In the caverns which they inhabited, in those in which they laid their dead, have been found fragments of their meals, productions of their industry and arts, and remains of their bones. It is in this book that their history has been read; it is with these documents that their past existence has been resuscitated.

Many *savants* have taken part in these researches. Among others, Christy, the Marquis de Vibraye, M. Falconer, and our two colleagues, MM. Louis Lartet and Elie Massénat, deserve honourable mention; but there is one name that eclipses all the others, it is that of the founder of human palæontology—Edward Lartet.

I.—*Determining the Epoch*

Before speaking about a people it is well to assign it a place in time. But in this instance ordinary chronology is inapplicable. We are touching on periods of an incalculable length. Since the epoch when our Troglodytes lived, the climate and fauna have undergone considerable modifications, which have been produced slowly, without any revolution, without violent action, under the influence of those imperceptible causes which are still at work in our own day; and when we consider that, during the course of centuries of known time, these causes have only produced scarcely appreciable changes in our surroundings, we can have some idea of the prodigious duration of what is styled a geological epoch. These immense periods can neither be measured by years, by centuries, nor by thousands of years; these dates cannot be expressed in numbers, but we can determine the order in which the geological epochs followed each other, and the periods of which each is composed. These are the dates of the history of our planet; and the elements of what Edward Lartet has designated *palæontological chronology*. It will suffice for us to determine our dates from the commencement of the *quaternary epoch*.

The end of the tertiary epoch had been signalised by a remarkable phenomenon, of which the cause is not yet perfectly known. The northern hemisphere had gradually become colder. Immense blocks of ice, descending from the sides of the mountains into the valleys and plains, had covered a considerable portion of Europe, Asia, and North America; and the temperature of our zone, till then torrid, had by degrees become frigid. The duration of this cold period, called the *glacial period*, was excessively long. After having attained their farthest limits, the glaciers retired considerably, then they advanced again, but without regaining their former position. This was the last phase of the tertiary epoch. The glacial period was nearly at an end. A gradual modification of temperature caused the melting of the ice, and the quaternary epoch commenced. The glaciers, those immense masses of snow, hardened by time and accumulated during thousands of ages, produced, when they melted, gigantic torrents, sweeping along in their powerful waves the ruins of mountains, flooding the plains, ploughing up the soil, hollowing the valleys and leaving in their track large deposits of sand, pebbles, and argile. From that epoch, called the *diluvian*, are dated our present rivers, but they give us in these days but a faint idea of what they were then.

The extraordinary power of the water floods was above all remarkable during the early part of the quaternary epoch; it gradually decreased from that time, but it was not until the glaciers had retired within their original bounds, until the temperature had become nearly equal to that of our own day, that the phenomenon of the great inundations ceased, and that the quaternary epoch drew to a close. Since that time, we still find sand and pebbles displaced, and sometimes even masses of more or less volume torn from the sides of the valleys by the torrents, but the rivers and streams no longer bear along with them more than particles of clay and slime, and these deposits have formed alluvial soil. The whole period which has elapsed since the close of the quaternary epoch bears the name of *present epoch*, and the soil which has been formed in this period is called *recent soil*. It is, certainly, recent, if we compare it with the quaternary soil, but not with reference to our ordinary chronology, for several hundreds of ages must necessarily have elapsed during its formation.

These considerations will aid us in comprehending the most essential facts which have served to establish the dates of human palæontology. These dates are determined in the first place by pure geology, in the second by palæontology, and in the third by prehistoric archæology.

The geological dates are chiefly inscribed in the valleys and in the plains, where the great floods of the quaternary epoch have left deposits in the shape of layers more or less regularly stratified. Except where some event has disturbed or excavated the soil, the layers are superposed in order of antiquity. The oldest are found beneath and are called low level; above them are ranged the middle level, which succeed them, and which are, in their turn, covered by the layers of the upper level, dating from the latter part of the quaternary epoch. We find a layer more or less thick of recent soil, formed of accretions, turf, vegetable matter, &c., covering almost all the quaternary soil.

It must suffice to explain in a general way how the study of the stratification of the layers, termed stratigraphy, enables us to determine the relative age of the recent or quaternary deposits. This primary classification is purely geological. Thanks to the data which it furnishes, we can calculate the period of existence of those animals whose bones are found in the different layers; these animals in their turn serve to characterise periods, and can thus establish the dates of certain soils, or of those partial deposits which do not form a part of a complete and regular stratification.

I. Among the animals living in our land at the beginning of the quaternary epoch, some, like the mammoth, no longer exist save in a fossil state; these are the extinct animals; others, like the reindeer, have disappeared from our climate, but still live in other regions; these are the

* Being the substance of the Address of M. Paul Broca to the French Association for the Advancement of Science, at the Session held at Bordeaux.

emigrant animals; others, like the horse, have survived to this day in our land, these are the existing animals.

The extinct animals abounded in the earlier quaternary age. Several were large and powerful mammalia, carrying terrible weapons of their own, and the human form looked weak and puny by their side. There were, among others, the great cave bear (*Ursus spelæus*), the great cave lion (*Felis spelæa*), the amphibious hippopotamus (*Hip. amphibius*), the rhinoceros with the expanded nostrils (*Rh. tichorhinus*), the ancient elephant (*Elephas antiquus*), finally and above all the giant, and we may say the king of this fauna, the mammoth (*Elephas primigenius*).

It would be superfluous to enumerate the other *extinct* species which lived at the same epoch. The reindeer and several animals, now *emigrants* like itself, were also to be found in this fauna, but they were still rare; and a good number of existing species had already made their appearance.

It is with good cause that the first period of the quaternary epoch, that which corresponds with the low level of the valleys has been called *the mammoth age*.

Every condition favourable to the prosperity of this species was then combined. But changes supervened which, in the long run, were to lead to its decay. The temperature had become less rigorous, and a great number of herbivora, till then stunted in their development by the inclemency of the atmosphere, had been able to improve and increase.

Already the mammoth saw arrayed against him the power of man, who, under this somewhat modified climate, could join in bands sufficiently formidable to declare war against him. Finally, and above all, this same climate, which suited his enemies and his rivals, had become hurtful to his own organisation, which required a colder temperature. The mammoth, therefore, so common in the earlier quaternary period, began to decline. We are inclined to think his existence was prolonged to the end of the palæontological age; but long ere that he had ceased to reign.

II. There was thus, in the middle of the quaternary epoch, an *intermediate age*, corresponding to the middle level of the valleys: an age in which several species contemporary with the mammoth were already extinct, in which others, represented only by solitary specimens, were on the point of disappearing, while those species were on the other hand flourishing, which were better adapted to the changing atmospheric conditions. Among these latter, the reindeer (*Cervus tarandus*) already occupied an important place, but it was in the succeeding period that it flourished.

III. This intermediate age gave way by degrees to the third and last stage of the quaternary epoch. When the layers of the upper level began to be formed, the species which we call extinct had almost entirely disappeared. A few rare mammoths still survived. Still more rare were the gigantic Irish deer (*Megaceros hibernicus*) and the great lion of the caverns. The rest of the fauna had but slightly changed, but the reindeer had multiplied to a wonderful extent. It formed at that time the chief nourishment of man. The third period of the quaternary epoch is therefore deservedly styled the Reindeer age.

The difference in the fauna of those days from that of our own time did not alone consist in the presence of the reindeer; many other hardy species, to whom a cold climate was necessary and a temperate one injurious, were still existing in our as yet frigid zone. When the state of the atmosphere more nearly approached that of the present day, there was a disappearance of the individuals which represented these species in our hills and plains; but the species themselves did not on that account perish. In the colder regions whither they had wandered they found a more congenial air, and they have thus been enabled to perpetuate themselves to the present time.

IV The disappearance of the reindeer and of the other emigrant species marked the end of the quaternary epoch and of the palæontological age. Then began the modern epoch. Our climate was probably still a little colder than it is in our own days, but it was already temperate, and the slight changes which it has since undergone have not affected the conditions of life to such a degree as to endanger the existence of species. If the urus (*Bos primigenius*) and the aurochs (*Bison Europæus*) have disappeared from our land, we must attribute these results more to the destructive action of man than to that of climate,* and to man is also attributed the introduction of several new species, for the most part domestic animals. With these few exceptions, we may say that from the end of the quaternary epoch our fauna has not changed, and that the recent soil only contains existing species.

The dates which we seek to establish are therefore determined at the same time by stratification and palæontology. They also rest on data of another order, and these constitute a real science, namely prehistoric archæology.

The point which is certain and which has been irrevocably proved by Boucher de Perthes, is that the most ancient beds of the quaternary epoch contain vestiges of human industry. The knowledge of metals only dates, one may say, from yesterday; before possessing these powerful auxiliaries, man was not unarmed. In the manufacture of his weapons and tools he had employed several hard substances, the bones, the teeth of large animals, the horns of the Ruminantia, but above all, stone, and more particularly flint; hence the name *Stone age*, given in the history of man to all the period which preceded the use of metals.

This stone age still continues among some savage nations, and it only came to an end among the civilised people of antiquity at an epoch very little anterior to the historic age. Hence it embraces nearly the whole duration of human existence. Now the mode of fabricating weapons, their shape, their nature, must necessarily have varied during this immense period, according to the changes in the wants, the mode of life, and the social state of man who employed them; and if we now consider that hard stones will last an indefinite time in the ground, we shall understand that the tokens of this primitive industry constitute indelible medals and chronological documents of the highest importance.

FIG. 2.

FIG. 1.

The type of Saint Acheul; Hatchet carved on both sides. Fig. 1.—Front view. Fig. 2.—Edge view.

The dates established by prehistoric archæology agree pretty well, and sometimes coincide in a remarkable manner with those of palæontology and stratification,

* The urus is now extinct, but it is not more than three or four centuries since it existed in Germany and Great Britain The aurochs is only to be found now in a forest of Lithuania, under the protection of a special law of the Russian Empire. A troop of them has been also seen in the Caucasus

Just as certain species of animals have perpetuated themselves since the earliest quaternary epoch, in like manner certain forms of hewn flint have been found almost without change through several archæological ages.

You have just seen that geologists have been able, more than once, to determine and designate an entire fauna from a single characteristic specimen; archæologists, in like manner, have chosen in each case the most characteristic tool to distinguish the different periods of the Stone age. We cannot strictly determine these periods and their precise number, for working in flint may have had many modifications at the same epoch, but in different localities. However, in studying the question in its entirety, we may, following M. de Mortillet's example, reduce to three the number of archæological periods of the quaternary epoch.

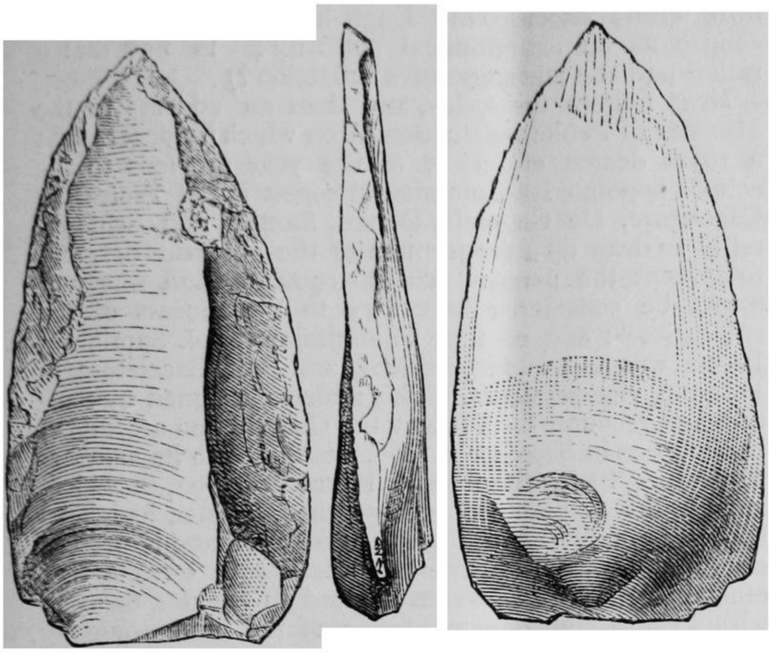


Fig. 4. Fig. 5 Fig. 3.
The Moustier type: Lance Point carved on one side. Fig. 3.—The plain side, cut out with one stroke; the projection of the bulb of percussion is visible at the base. Fig. 4.—The carved side. Fig. 5.—Edge view.

I. The most remarkable type of the early quaternary age is the hatchet of St. Acheul (see Figs. 1 and 2). It is a flint of varying bulk, always rather large, longer than it is wide, thick in the centre, graduated towards the edges, presenting one extremity pointed, or rather arched, while the other is rather rounded; and the predominant characteristic is its being carved on both sides, and the sides are more or less convex and more or less symmetrical. This type abounds at St. Acheul, near Amiens, in the valley of the Somme, hence its name; but it has been found in most of the beds of the Mammoth Age. It is sometimes, but rarely, to be met with in less ancient beds.

II. A second epoch of the Stone Age is characterised by the point of Moustier (see Figs. 3, 4, and 5). This weapon, which was fixed to the end of a huge lance, presents an exterior contour not dissimilar to that of the hatchet of St. Acheul, unless, perhaps, in being slightly more pointed; but its distinguishing mark lies in its being carved on one side only; the other side is cut out with one stroke, and has not been retouched. It is not therefore biconvex, like the other, but planoconvex, and consequently half the thickness.

The Moustier type takes its name from the Moustier Cave, where it is very common. It was not common until the intermediate period.

III. The art of cutting flint was perfected in a third epoch, which corresponds with the Reindeer Age. The pointed or sharp-edged weapons became less massive; the contours and sides were more regular, more symmetrical, and a delicate touching up, in fine little strokes, graduated them towards the edges. This period of the Stone Age is less marked by the nature of the weapons than by the style of workmanship. It is, however, agreed to take as a type the lance point of Solutré, because a short time since the lances found at the station of Solutré, in Mâçonnais, were the best-cut weapons that had been extracted from the quaternary beds (see Fig. 6); but, since then, Dr. Jules Parrot, and his brother M. Philippe Parrot, have found at Saint Martin d'Excideuil (Dordogne), in a cave of the Reindeer Age, several flints carved in a yet superior style.

IV. We have now arrived at the end of the Reindeer Age. Directly the present epoch opens upon us, we see apparent in the flint cutting a further improvement, which marks the commencement of a new archæological era. Up to this time the flint had only been fashioned by pressure or percussion. They had learnt, it is true, to round by friction some objects in stone in a very rough style, but the weapons and tools in flint were always hewn. In the new era now commencing, many weapons were still made of cut flints; but from that time forth they knew how to polish them, and the polished hatchet, too well known to need description, became man's principal auxiliary (see Fig. 7).

This hatchet characterises the epoch of polished stone, or the neolithic epoch, which terminates the age of stone, and which, consequently, lasts until the introduction of metals. The entire period preceding the appearance of the polished hatchet constitutes the epoch of hewn stone,

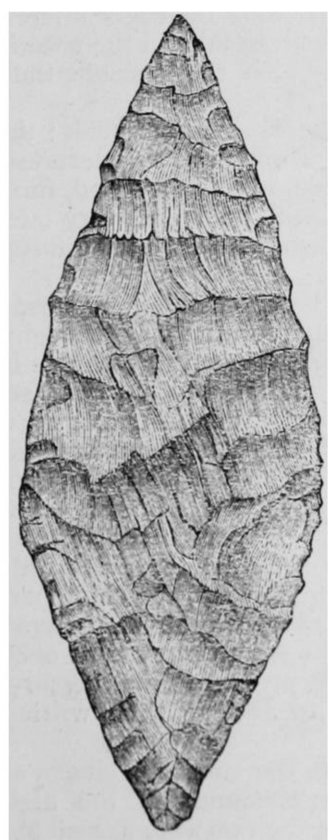


Fig. 6.

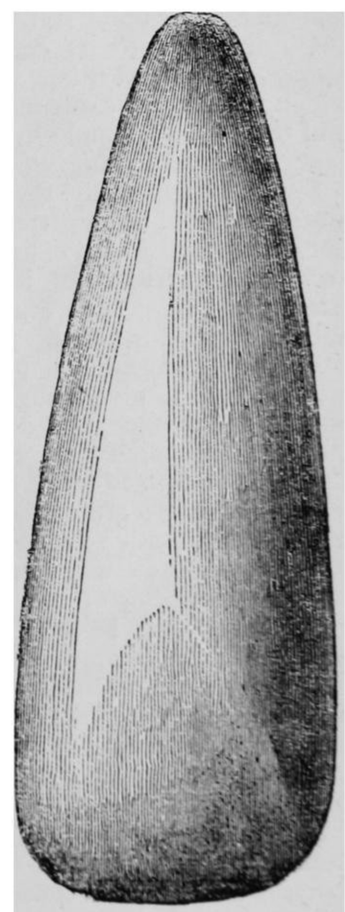


Fig. 7.

Fig 6.—The type of Solutré: Lance Point of Solutré (Hamy. Human Palæontology). Fig. 7.—The Polished Hatchet.

which is also called the archæolithic epoch, or better still palæolithic.

The different phases of the epoch of hewn stone succeeded each other progressively and by almost imperceptible transitions, like the corresponding geological periods; the epoch of polished stone, on the contrary, stands out clearly and almost abruptly from that which preceded it. Its commencement coincides exactly with the disappearance of the reindeer, that is, with the end of the palæontological age, and with the commencement of the present epoch of geologists. It likewise coincides with a complete change in the social condition of man, with the domestication of the dog, with pastoral life, marked by the domestication of several herbivora, and soon after with agriculture. A long succession of ages then elapsed, until the appearance of bronze, which put an end to the Stone Age. The epoch of polished stone was therefore a very long one ; compared to this the whole period of historic time sinks into insignificance : nevertheless, this period of polished stone, however long it may appear to us, was infinitely shorter than any of those of which the epoch of hewn stone is composed.

(*To be continued.*)

THE ITALIAN REPORT UPON THE ECLIPSE OF 1870*

THIS is a folio volume about an inch thick, in a yellow paper cover. It is a well-printed book, made of tolerably good foolscap, and as the title-page informs us, produced at the expense of the Italian Government, under the care of Prof. Sir G. Hunter, as we should call him, but in his native tongue, Il Cavaliere Professore G. Cacciatore †; and the first remark that occurs to one on looking through it is that whether the Government paid handsomely, or whether it gave with a grudging stinginess, its cash was at all events well laid out, alike without extravagance and without meanness, and that the result reflects honour upon Italy.

On dipping into its contents here and there in a cursory way, the next thing you notice is the eager interest which the several contributors seem to take in their work, and the earnest simplicity with which they recount their experiences and achievements.

Speaking generally, the volume is a picture-book ; the plates, some of them distributed through the letterpress, but accumulated in a considerable mass at the end, form an important feature of it, and will be found very interesting and suggestive even to those who are not so fortunate as to read the text.

For the convenience of the latter class of persons, I propose now to give a slight sketch of the report, beginning at the preface, and describing the several papers in the order in which they occur ; and if, whilst doing so, I should venture to make any comments, the reader must remember not to attach too much weight to them, because it is hardly possible for a foreigner to do justice to men whose words and ways must always bear from his point of view something of the interest proper to pictures by the old masters. I ought not to presume to review this book critically, because, in the first place, the chief performers concerned in it are in every way my superiors ; and in the second place, I am obliged to confess at once that they are personally so vividly present in my memory, that it seems almost a rudeness to analyse their writing for public uses.

I find it impossible to eliminate the romantic charm of their manners, and my own recollections of the high courtesy they showed towards us when we were associated with them in Sicily.

A slight reflection of this latter will be perceived by the reader the first time he opens the book. Fronting the title-page he will find a lithographed drawing of the station at Augusta, purporting to show the several observatories, in which those of the Italian astronomers are shown in the background ; whilst the rough shed of the English observers, and the tents in which they were encamped, form the most prominent features of the picture. In passing from this first page of the volume, I must testify to the singular faithfulness of the drawing.

After the title-page there occurs a short paragraph, consisting of Prof. Cacciatore's apology for the delay in the production of the Report. (By the way, I wonder what our unfortunate editor will say in this respect when, after we are all dead and turned to dust, he produces at his own untold expense the English report of the same eclipse as an astronomical curiosity ! Is not that a rather pathetic and suggestive reflection ?)

Next follows the index, and then an address to the Minister of Public Instruction, from which it appears that a royal decree of July 5 of the year previous to the eclipse appointed a Commission consisting of Professors Cacciatore, De Gasparis, Donati, Santini, and Schiaparelli "to draw up a programme of the observatories, and to appoint the persons, the instruments, and whatever might be considered necessary to the success of the enterprise"; and of this Commission, Prof. Santini of Padua, was appointed president, and Prof. Cacciatore, of Palermo, vice-president. This address is signed by Santini, and recounts further how the Commission assembled in Florence in September 1869, and added to its numbers Professors Padre Secchi and Pietro Blaserna, of which, and of all its other proceedings, the Minister had been kept informed. Santini goes on to say that his present duty is to express the thanks that Science owes to that official for the eagerness he showed in backing them up with a considerable augmentation of the fund originally appropriated, and getting placed at their disposal a Royal steamship, and so on.

He then says that, owing to his advanced age, the chief burden of the work fell to the lot of Cacciatore, and that, thanks to his careful diligence, and so on, things were got ready nearly as intended ; the "nearly" being a consequence of the extraordinary political changes of the preceding year. Cacciatore however seems to have found it no joke, and the part confided to him, he says, was very arduous and rugged ("ben ardua e scabrosa").

Here follows Cacciatore's account (*relazione*) of all that he did, and it forms, perhaps, the most interesting chapter of the whole book. The rest of the observers pass before the reader in single file, each relating what he saw and did, in his own words ; but Cacciatore gives us a peep behind the scenes, and tells us what was done in the way of preliminary arrangement, and how he tried to aid every man in the manner best calculated to develope his own particular abilities ; and in these operations (if I may be allowed to pass a remark) he appears to have done his work in a masterly way ; and he relates the story with a graceful facility that makes it most attractive reading. He describes his preliminary canter over the course of the totality in search of a suitable site for the observatories ; tells how he first examined the neighbourhoods of Villa 'Smunda and Terranova, as affording beyond all doubt the most favourable conditions, and how he afterwards reluctantly abandoned the former on account of its unhealthiness, and fell back on Augusta for his chief station, the fortress of which he describes, and says he found it admirably adapted for the purpose. Most truly it was so ; and if I were to give an account of it, I should find Cacciatore's allowance of adjectives very inadequate to convey my impression of its attractions, although December was by no means the month in which they could be fairly appreciated.

Leaving his colleague, Tacchini, there to make preparations, he returned to his observatory at Palermo, which formed the base of operations. After this he gives a summary of the instruments, the observers, and the *role* assigned to each, and tells how he marshalled them in two complete and independent divisions, one of them destined for Augusta and the other for Terranova. On November 25 the steamer *Plebiscito* cast anchor at Palermo, having

* Raporti sulle osservazioni dell'Eclisse totale di Sole del 22 Dicembre, 1870, eseguite in Sicilia dalla commissione Italiana.

† He always signs himself G. Cacciatore, but his first name is Gaetano.

picked up on her way from Genoa certain members of the expedition, with their instruments, and on the 27th they got under weigh again and proceeded to the east coast of the island, where they admired the scenery, and where their otherwise considerate and polite captain, Il Cavaliere Foscolo, strangely neglected the opportunity of running them ashore.*

Arriving thus at their citadel, nearly a month in advance, and finding that ample preparations had already been made, they were now in a position to devote themselves quietly to their own particular pursuits, and to carry on their experiments with reference to the important occasion. However, they were no sooner comfortably settled than their troubles began, somewhat after the fashion of Job's—"a great wind from the wilderness smote the four corners" of the fortress, and threatened to leave poor Cacciatore alone to tell the tale; and he seems to have had to put up with not a little "chaff" from his comforters as to his selection of a site; but he consoles himself with the thought that it would have been all the same if he had settled anywhere else.

Then follows a little paragraph about the English, which I may as wall translate:—"Meantime the most enlightened Prof. Adams, together with several of the numerous English Commission—others having remained in Catania—escaped from the misfortune of the *Psyche*, a magnificent steamer of the British Navy, stranded amongst the coasts of Acireale, arrived in Augusta for the observation of the phenomenon. Colonel Porter, of the Engineers, accompanied by soldiers of the same arm, having preceded them, visited our temporary establishment, passed graceful encomiums on the organisation, and planted tents and barracks (huts) at the foot of our fortress, and at the extremity of the open space which divided it from the town. With these distinguished gentlemen we maintained such friendly and cordial relations as are becoming between the citizens of cultivated and free nations."

The incidents of the three or four days preceding the eclipse, and the anxieties caused by the weather, are told with a graphic vividness that will cause those of us who were there to live over again through that period of painful suspense, a suspense only less felt by the English because of the demands made on their energies by the hurry and hard work of preparation. For we had to do in a five days' encampment in a foreign country what they very reasonably employed more than a month to do in their own. After describing the fitful changes of the wind, clouds, and barometer, which kept them oscillating between hope and dread up to the very beginning of the eclipse, he says: "And just then the sun appeared radiant and luminous, so as to provoke a cry of joy from as many as stood intent to observe him. So it went on until the moment of totality; but then some clouds began to traverse the obscured disc, and so rapid was their movement and their succession one after another, that they influenced the degree of visibility to each one of the observers in a different sense, and in such a fashion that there were some of them more fortunate and others less so." This admirably careful description corresponds perfectly with our own experience, and should be duly taken into account when the value of the observations comes to be considered. Cacciatore's own estimate of the work done, an estimate formed on the spot immediately after the eclipse, when he came to review his company, is expressed in reserved and general terms as follows:—"I was able to satisfy myself that alhough the sky was not largely propitious, it nevertheless conceded to us a certain interval, the fruits of which had been reaped to the utmost; and that if in general the observations of the eclipse of 1870 turned out unfortunate, the Augusta division would be able to supply facts which would not be without importance in the present state of science."

He then proceeds to summarise the results as follows:—

"Padre Secchi had assumed the photographic department, and the spectroscopic determination of the protuberances previous to the eclipse, with the view of being able to compare them with those which should be seen during the totality. The position and the shape of these were obtained on the morning of the same day, favoured by a fine serene sky. Ten photographs were made during the phases, and at the moment of totality photographs of the protuberances were obtained, in spite of the obstacle of a cloud. At the same time their forms were directly noted, and immediately afterwards were confronted with the spectroscopic figures. The spectrum of the most acute cusps of the sun was studied, and photographs of the later phases were taken until the end of the eclipse.

"Prof. Denza made spectroscopic observations of the corona, which discovered two bright lines, one near the E, the other probably of nitrogen (*dell' azoto*). Together with Signor De Lisa they observed and drew the protuberances.

"Prof. Donati in the time of totality was able to see the bright lines of one protuberance already studied before the eclipse. He saw the lines of hydrogen and one line in the yellow more refrangible than the sodium, but did not see any of the iron lines.

"Prof. Blaserna examined whether the corona contained polarised light. Employing a Savart polariscope applied to a refracting telescope of moderate magnifying power, he was able to examine three points situated at 45° from each other. The polarisation was most pronounced, and very nearly of the same intensity as the atmospheric polarisation seen recently on clear days at about 50° from the sun. At the distance of a degree and a half from the moon not a trace of polarisation was seen, the influence of the air, therefore, in the observed phenomenon remains eliminated. The plane of polarisation was found in all the points radial or tangential to the sun's limb. It remains then established that the corona is polarised, and hence contains reflected light sent out from the photosphere.

"The purely astronomical part assigned to me (the director) was, as far as the variable condition of the heavens admitted, fulfilled to the best of my ability. I was able, in fact, to note with some precision the instants of first contact, and the beginning of totality and the end of it (although the last through the clouds), besides some other observations which I shall refer to afterwards."

This summary concludes with a mention of the magnetic and meteorological observations, and the Professor goes on to remark concerning the station at Terranova, that the circumstances there were not dissimilar to those at Augusta—the same strong wind and clouds interfered as at the latter place.

Thus ends the general account of the operations described by the leader of the expedition—a most interesting introduction, and well worthy of the seven independent papers from Augusta which follow it, to which are added about the same number from Terranova, and some dozen more abridged accounts by outsiders, which form an appendix.

The leading place is accorded to that most accomplished of ecclesiastics, Father Secchi, who, in his ringing and trenchant style, gives a vivid picture of the whole experience, from the ordering of the instruments to the ultimate effect of the phenomenon. Next follows Donati, "in a speech curt tuscan, sober, expurgate, spare of an 'issimo,'" as Robert Browning says, in which the blunt but attractive manners of that genial soul are nearly as appreciable by the reader as if he were present in the flesh. After him Cacciatore details his own observations

* When it came to the knowledge of this gentleman (through the ever attentive Secchi) that our military escort, in consequence of "superior orders," had taken away our tents, and left us without shelter upon the open glacis at Augusta, he sent us a polite message, placing his ship at our service in the handsomest manner.

in his gracefully fluent yet finished style, and then come Blaserna's polariscopic experiments, clearly and energetically expressed, and, as far as I can judge, affording most conclusive results. It is not a little remarkable how much is contributed towards the value of the observations by the manner in which each observer relates them. The descriptions are given with such charming naïveté and absence of affectation, that the reader can appreciate almost the exact degree in which the writer's hand shook as he manipulated his instrument, not to speak of the degree in which his assertions can be relied upon for accuracy or freedom from bias.

JOHN BRETT

NOTES

M. JANSSEN has been elected a member of the Astronomical Section of the French Academy, the votes recorded for him being 42, against 13 for M. Loewy, and 1 for M. Wolff.

AT a recent meeting of the Natural Science Section of the Literary and Philosophical Society of Sheffield, a discussion took place on "The Attitude of the State to Science," in which Dr. Hime, Mr. Alfred H. Allen, Mr. H. C. Sorby, F.R.S., and Mr. J. Spear Parker successively took part, and the opinion of the meeting was embodied in the following resolution, which was passed unanimously:—"That this meeting deplores the supineness of the Government with respect to science, and believes that the national recognition of research, and the establishment of better means of rewarding discoverers, would be a direct benefit to the country."

IN order to remove any apprehension that might arise in the minds of some members of the Anthropological Institute (particularly of those residing in the country), from statements made that, in consequence of the recent change in the composition of the Council, a preference would be given to papers of an ethnographical class over those relating to other branches of anthropology, the director, with the full concurrence of the president, has thought it advisable to assure the members of the Institute that no such result need be feared. Papers on every branch of anthropology will always be cordially received, provided they comply with the requirements demanded in all communications to a Scientific Society intended for publication, amongst which, a very essential one is, that they should contain either "new facts or new applications of admitted facts." As a further assurance that all proper subjects will receive due and equal attention, it may be well to state in general terms what may be regarded as proper subjects to be brought before the Anthropological Institute. They may be included under the following heads:—(1) The Physical History of Man and of the Human Race; (2) Psychology; (3) Comparative Philology; (4) Priscan Archæology, *a* Prehistoric, *b* Protohistoric; (5) Descriptive Ethnography, comprising the Reports of Travellers and Explorers on the Physical Characters, Derivation and Relation, Manners, Customs, Religion, Language, &c., of various Races or Nations; (6) Comparative Ethnography; (7) The Relations between Civilised Man and Aboriginal Savage Peoples. In this programme it will be seen that any subject properly coming under the cognizance of the anthropologist may find a place. And in order to insure confidence that each and every subject will receive due attention, it is suggested that committees might, if thought desirable, be formed of such members of the institute as may take a special interest in any of the above branches of inquiry, whose function would be, each in its own sphere, to promote the collection of materials and the production of papers relating to the subject in which they may feel particular interest. In this way it is clear that all the subjects will be placed on an equality, and to be hoped that each in its turn will receive the same attention.

SOME weeks ago we expressed a hope that the vacant Swiney Lectureship would not be given to one who is already well off, but to some well-qualified young man, who would thus have leisure to perform work of high scientific value. Our hope, we are glad to see, has been essentially fulfilled in the appointment of Dr. Carpenter, who, unusually young in spirit, assuredly deserves the leisure which this appointment will ultimately help to bring him, leisure which, we have good reason to believe, will be devoted to the completion of work of very high scientific value indeed. Few men have devoted gratuitously more of their time to the public benefit, and we believe that he accepts the appointment mainly in order that he may have a good opportunity of working out in fuller detail the applications to geology of the inquiries in which he has been engaged during the last few years. Dr. Carpenter, we understand, has had by him for years, the material, fully worked out, of important papers which he has had no time to produce. Dr. Carpenter has once before held the Swiney Lectureship, and it has been offered to him again without any solicitation on his part.

ON Monday last, in the first of his Hunterian lectures for this year, Prof. Flower drew special attention to the peculiarities of a new animal discovered by Prof. Marsh, of Yale College, and named by him *Dinoceras mirabilis*. This remarkable ungualte, nearly the size of the elephant, was obtained from the Eocene beds of the Rocky Mountain region. It possessed osseous cores for three pairs of horns, which rise successively one above the other; a supra occipital crest is greatly developed, projecting obliquely backward beyond the condyles. The posterior pair of horns arise from this crest, the median from the maxillaries, and the anterior from the tips of the nasals. The canines are greatly developed, and the upper incisors are wanting. The skull is unusually long and narrow, and carries six small molar and premolar teeth. The extremities resembled very nearly those in the proboscidia, but were proportionately shorter. The femur possessed no third trochanter and no pit for the ligamentum teres. It therefore possesses characters allying it with the perissodactyles as well as the proboscidia.

PROF. MARSH has also drawn attention to a new sub-class of fossil birds from the cretaceous shales of Kansas. The specimens, while possessing the scapular arch, wing, and leg-bones of the truly orthnithic type, present the very aberrant conditions of having biconcave vertebræ and well developed teeth in both jaws. These teeth are quite numerous and implanted in distinct sockets; the twenty in each ramus of the lower jaw are inclined backwards and resemble one another. The maxillary teeth are equally numerous and like those in the mandible. The sternum have a carina and elongated articulations for the coracoids. The lower of the posterior extremities resemble those of swimming birds. The last sacral vertebra is large, so it may have carried a tail. Professor Marsh proposes the name *Odontornithes* for the name of the new sub-class, and *Ichthyornithes* for the order to contain this remarkable species, which is about the size of a pigeon.

AT a meeting of the Senate of the University of London held last week, a resolution was passed by a majority of two, that it is desirable to make Greek an optional subject at the Matriculation Examination. The practical effect of the carrying out of this regulation will be, that while those who are intending to proceed to degrees in Arts will continue to take Greek at the matriculation, as a matter of course, it will not be required from those who are going on to degrees in Science or Medicine.

MR. A. W. BENNETT, M.A., B.Sc., F.L.S., has been elected Lecturer in Botany at St. Thomas's Hospital School of Medicine, in the place of the Rev. J. W. Hicks. A vacancy is thus caused in the Lectureship on Botany at the Westminster Hospita School.

THE following new candidates for the Professorship of Geology at Cambridge are announced :—Mr. William King, Professor of Mineralogy and Geology, Queen's College, Galway; and Mr. P. Brodie, M.A., F.G.S., of Emmanuel College, and Vicar of Rowington.

THE office of Chief Assistant in the Observatory, Cape of Good Hope, will be filled up by open competition on March 18 next, and the following days. Candidates must be between eighteen and twenty-five years of age, and the salary commences at 320*l.*, rising 10*l.* a year to 450*l.*

WE are really sorry to hear that the much-talked-of Arctic expedition of M. Pavy, who was recently fabled to have discovered an Arctic Continent, has vanished into worse than "thin air." It is perhaps unprecedented in the annals of science that the funds meant to be devoted to a noble and heroic purpose, should be literally wasted in riotous living. We hear, on too good authority, alas, that M. Pavy's explorations have been confined to certain not unknown phases of "life" in San Francisco.

COAL has been discovered on the railway from Mollendo to Arequipa in Peru. The seam is four yards thick. The coal has been reported as of good quality, and it is already being used on the railway.

DR. REISS, one of two German travellers in Ecuador, has succeeded not only in ascending Sotopax, but in entering the crater.

A GERMAN from Berlin has been for some time at Panama butterfly hunting. His first remittance was one hundred pounds' worth of butterflies.

ON December 28, 1872, a slight shock of earthquake was felt at Goalpara in Northern India, and again on January 3.

ON December 28, 1872, a strong earthquake was felt at 10 A.M., doing much damage at Chinameca, Salvador, Central America. It is attributed to the volcano of San Vicente, now in eruption.

ON January 1 there was a slight shock of earthquake at Guayaquil.

THE *Times of India* reports a sharp shock of earthquake which was felt on January 7, about 4 P.M., at the camp between Sultanpore and Fyzabad, in Oudh.

THE great shock of earthquake in Samos on January 31 happened at 1.10 A.M., and lasted 10 seconds. Several houses were thrown down, and many damaged.

THE French authorities at Tahiti report in their official journal that, in consequence of changes in the coast line and reefs, new rules for navigation have been issued. They announce, also, that the island placed in 21° 50′ S., and 152° 20″ W., does not exist, as the place has been sailed over by three vessels. Captain Truxton, of the U.S. ship *T. Jamestown*, has informed them that he has passed over the position of a reef assigned to 24° 45′ S. and 150° 40′ W., without seeing any token of danger.

M. DE FONVIELLE has been authorised by the French Academy to make a series of experiments on a new lightning conductor which he has devised.

THE Report of the Marlborough College Natural History Society for the half year ending Christmas, 1872, contains much that is of considerable interest and value, though we are sorry to see from the very honest preface, that the Society is not in so satisfactory a condition as it ought to and might be. While admitting that a fair amount of work has been done, the preface complains of the lack of interest in the work of the Society, and the comparatively small amount of energy displayed by many of the members. With regard to nearly all the sections, the tone of the preface is desponding, though hopeful that a change for the better may take place next year. The Society contains some excellent workers, who have shown no disposition to relax their efforts, and we earnestly hope that their example will be largely contagious, and that the next report will be written in a very different tone. It is a pity that a society so favourably situated in many respects as this is should not produce more abundant and more valuable results. The geological section, we are sorry to see, is nowhere, mainly for want of a permanent head. The society is also very much cramped for want of a suitable building for the museum. We hope this report will stimulate all the members to renewed activity; let them take to heart the very excellent advice given in the paper on "An Ideal School Natural History Society," by Mr. E. F. im Thurm, who deserves great praise for his efforts on behalf of the society. Appended are reports of the out-door work done in entomology and botany during the half year, and a long and very interesting paper by the Rev. J. A. Preston, describing what he saw on a recent visit to Brazil. The concluding article of the Report is Part I. of a carefully compiled descriptive Catalogue of the Archæological Collection of the Society, by Mr. F. E. Hulme, which is accompanied with a beautifully executed illustration of some of the articles in the collection.

AT the first meeting of the Sheffield Naturalists' Club held a few days ago, Mr. H. C. Sorby, the president, delivered a very excellent inaugural address, in which he gave his views as to the objects of the formation of such a society. Such a society as this, he said, had two characters. First of all, the subjective influence it had on the members who composed it. The study of natural history was most desirable in many ways. Man had a certain amount of energy; it must be expended in some way or other, and the examination into natural history furnished them with a study which was advantageous to both body and mind. By being joined together in a society they might greatly help one another. With regard to the objective value of such a society as this, he thought they ought not to limit their efforts to the mere making out of accurate lists of flora and fauna which occurred in the district. The efforts of naturalists also ought to be devoted to the discovery of general philosophical principles, as applied to both animals and plants. He thought they could learn a great deal more by the careful study of the commonest things than by looking for rarities. They could not hesitate in saying that a great deal remained to be done in the study of natural history in every district. The following, he thought, were some of the points which such a society should inquire into: —What is life, and how have the various species of animals and plants originated? Why do particular plants grow in particular localities? The determination of that question would have a most important bearing on geological theories. Another problem for study was what was the effect of dry or wet seasons on certain plants? If that question were settled, they might know the effect that must have been produced in bygone ages—by the alteration of climate—on certain plants and animals. Another most interesting subject for investigation was the influence of plants on plants, animals on animals, and one on the other; the fertilisation of plants by insects, and the attractability of different colours for different insects. Other points recommended for study were the following:—The manner in which the habits of animals have been acquired; the manner in which varieties or species have been formed; the limit of the successive generation of insects through none but females; the diseases of plants due to parasitic fungi and insects.

THE first number of Petermann's *Mittheilungen* contains a brief account of the eruption of a new volcano in Chili, which occurred during part of last June and July. The volcano, known by the name of Lhagnell, is situated in the south of the country, in Arauco, between the volcanoes Villarico and Llaima, near the river Cautin. Immense quantities of sand seem to have been thrown out, some of which, according to Dr. Philippi, of Santiago, reached a distance of 300 or 400 miles north from the volcano. This sand is described as consisting of angular, transparent green particles of volcanic glass. Dr. Philippi also reports that for fourteen days, about midday, a strong south wind blew, as far north as Santiago, small quantities of sand, much coarser than the above, with rounded corners, opaque and grey. Great quantities of lava, according to the report of a spectator, have overflowed the district, causing considerable destruction to life, and stopping up the river Quepe, which is thus being converted into a considerable lake.

WE have received a small pamphlet, by Mr. B. H. Babbage, containing a description of a portion of the late Mr. C. Babbage's calculating machine or difference engine, put together in 1833, and now being exhibited in the educational division of the South Kensington Museum.

La Revue Scientifique for February 15, gives a summary of the much needed administrative reforms which have been introduced into the Collége de France.

WE have received the following papers recently read before the Eastbourne Natural History Society:—"On *Geoglossum difforme* or Earth-tongue," by Mr. C. J. Muller; "A Note on the Wall Pelletory," by Mr. F C. S. Roper; "On the Planet Venus," by Mr. T. Ryle.

THE principal articles in the *Quarterly Journal of Science* are:—"On the Probability of Error in Experimental Research," by Mr. Crookes; "Condition of the Moon's surface," by Mr. R. A. Proctor, with photograph; "Colours and their Relations," by Mr. Mungo Ponton; and "Remarks on the Present State of the Devonian Question," by Mr. H. B. Woodward.

THE *Annual of the Royal School of Naval Architecture*, &c., contains some good technical papers. This publication will become vastly increased in importance, and we hope in value, by the establishment of the new school at Greenwich.

WE take the following from the *Engineer*:—The question as to whether a gasometer will explode when fired was settled in Manchester on Tuesday, February 11, when one of the gasometers at the Manchester Corporation Gasworks in Rochdale-road was destroyed by fire. The origin of the fire is not known, but about 2 o'clock a workman saw flames issuing from one end of the gasometers, and the flames could not be checked till the whole contents of the gasometer, about 600,000 cubic feet of gas, had been consumed. Many inhabitants of the neighbourhood hurried away with loads of their furniture, fearing an explosion, but nothing of the kind occurred.

ADVICES from Cyprus state that no rain had fallen on the island for months; but this is probably an exaggeration.

WE learn from the *Athenæum* that the Rev. Thomas Hincks, F.R.S., is now engaged in preparing a "History of the British Polyzoa."

PROFESSOR RAMSAY ON LAKES

PROF. RAMSAY F.R.S., delivered a course of six lectures to working men, on Monday evenings, commencing Jan. 5, 1873, in the Lecture Theatre of the Geological Museum. The subject of the course was "Lakes, fresh and salt: their origin, and distribution in geographical space and in geological time," and the following is an abstract of them:—

I. FRESHWATER LAKES, THEIR ORIGIN AND GEOGRAPHICAL DISTRIBUTION

There are many classes of lakes in the world, formed in various ways, and though he had been unjustly charged with ascribing all lakes to one origin, he would be the last person to do so. He then went on to examine the various means which might be supposed to produce lake basins, and especially that class of lakes scattered over the whole northern hemisphere—in Wales, Cumberland, Scotland, Sweden and Norway, Russia. and N. America—the basins of which had evidently been formed by the erosion and grinding out of portions of the earth's crust. In many cases these lakes are in true rock basins, surrounded by lips of rock. How were these hollows produced by Nature? The dislocations of the earth's crust could not produce them; as a rule the sides of faults are close together or the fissure is filled up with other matter, and the depressions due to synclinal curves were never so simple or perfect as these lake basins, owing to violent disturbances, and to subsequent denudation. The theory of a special area of subsidence for each lake seems absurd, on considering the vast numbers of separate lakes, in N. America for example, lying in some case within a mile or two of each other. Again, a lake cannot make its own hollow; what little motion there is in the water can only affect the waste of the shores. Neither can a river scoop out a lake hollow, it can only produce a long narrow channel, and go on widening and deepening that, and the sediment which it carries down into the lake will in the long run fill up the lake basin. The action of the sea, too, on its shores cannot scoop out a lake hollow, it can merely wear back its cliffs and form a "plain of marine denudation" just below the level of its waters. And thus having exhausted all the other natural agencies which effect the denudation of the land, what agency remains to us to account for the formations of these lake basins, but the grinding power of ice? The lecturer then adverted to the phenomena of the formation and progress of glaciers, illustrating his remarks by diagrams of the great Rhone glacier. In the Alpine valleys there are numerous indications—in the mammellated surface of the rocks, the striation, moraines, and boulders—that at some period in the past all these glaciers had been very much more extensive than at present, and were found in many parts where now they are altogether wanting. In Greenland the whole country is covered by a universal ice sheet, which extends into the sea in some cases several miles, and where cliffs of ice rise out of the sea 200 to 300 ft. high, and, as recent soundings have shown, are sometimes 3,000 ft. deep. Large masses of these breaking off float away as icebergs, bearing with them stones and rubbish which they deposit, on melting, irregularly over the sea bottom. In the mountains of Wales and Scotland, in the Vosges, the Black Forest range, and in N. America are numerous signs of glacier action, all which prove that at one period, recent in a geological sense, glaciers were present in those districts; and boulders and boulder clay deposits show also that the Northern part of the Northern hemisphere was passing through a glacial epoch.

Boulder clay and moraines have sometimes dammed up a stream of water and formed a lake, but lakes of that kind are neither numerous nor of much importance. The theory that the true rock basins were scooped out by glaciers first occurred to the lecturer whilst observing in N. Wales, and he applied it first to the explanation of the tarns about Snowdon, but extended observation of the Italian and other great lakes, and subsequently of the American lakes, warranted him in applying it to them also. He had especially applied it to the Lake of Geneva, which lies directly in the course of the old Rhone glacier. The lake is 983 ft. in depth in its deepest part, nearly in the centre. Where the glacier entered the lake it could not have been less than 3,000 ft. thick, and as the rock underneath is comparatively of a soft character, where the ice was thickest the grinding power was greatest, and it scooped out its deepest hollow; but towards the south end the mass had grown less through melting, and the result was a shallowing of the basin It is in the valleys of Switzerland down which the glaciers must formerly have extended that the lakes lie. The great depth of Lake Maggiore beneath the sea-level—2,300 ft.—is no argument against the theory, for a large mass of ice would block out the sea-waters. In Wales the lakes are never of large size, Lake Bala, the largest, being about 4½ miles long; Lake Windermere lies in a true rock basin, as do many others in that district; in Scotland, where the climate was more severe, the lakes are larger and more numerous; in Sweden and Norway, in Finland and N. Russia the lakes are almost innumerable, while in N. America they are scattered almost broadcast over the country N. of lat. 43°. Where the glacial action was most intense, there the lakes become more and more numerous, and he believed they were due not to special glaciers, like those on the south side of the Alps, but to that great ice sheet which, according to Agassiz, covered the whole country. In South America and New Zealand, too, are signs of a similar action, and there too, lakes of this class occur. The present glaciers of New Zealand are very small compared with what they evidently were at a previous period, and in the course of every one of them are lakes, which, according to reports he had received, also lie in true rock basins.

II. Salt Water Lakes, their Origin and Geographical Distribution

The lecturer said that he could not account for the origin of all salt-water lakes, but for some of them the evidence is clear, and it is plain to see why they are salt. The principal minerals forming the rocks of the earth's crust are silica, alumina, lime, potash, soda, magnesia, peroxide of iron, &c. Rain-water takes up from the atmosphere and the earth's surface a small proportion of carbonic acid, and thus acquires the power of dissolving certain of these minerals as it percolates through the rocks, notably lime, which it carries away in the form of a bi-carbonate. And thus the water of all springs is charged more or less with mineral ingredients, though these may be recognisable only by the skill of the chemist. Thus the water of the fountains in Trafalgar Square contain 69·75 grains of salts per gallon, including chloride of sodium 25·7; bi-carbonate of soda 14·5; sulphate of soda 18·4. The Thames water at Teddington contains 22·5 grains per gallon, and thus carries to the sea in the course of a year 377,000 tons of salts; the old well at Bath holds 144 grains of salts per gallon, thus bringing to the surface 608 tons of salts per year. The apparently small quantity of bi-carbonate of lime in a per-centage of the salts of sea-water, is still sufficient to furnish to marine creatures materials for their shells and skeletons, and thus indirectly to build up the great beds of limestone which are now in course of formation, or belong to former geological periods. The analyses of salts in sea-water and in the water of various lakes is given in the following table:

Per centage of	Mediterranean Sea.	Black Sea.	Sea of Azof.	Caspian Sea.	Dead Sea.
Chloride of Sodium.....	2·9460	1·4020	0·9658	0·3673	12·110
,, Magnesium	0·3223	0·1304	0·0887	0·0632	7·822
,, Calcium.....	—	—	—	—	2·455
,, Potash.......	0·0505	0·0189	0·0128	0·0076	1·217
Bromide of Magnesium	—	0·0005	0·0004	trace	
Sulphate of Lime	0·1357	0·0105	0·0288	0·0490	}
,, Magnesium	0·2480	0·1470	0·0764	0·1239	}
Bromide of Sodium	0·0558	—	—	—	} 0·452
Carbonate of Lime......	0·0113	0·0359	0·0022	0·0171	}
,, Magnesia	—	0·0203	0·0129	0·0013	}
Peroxide of Iron........	0·0004	—	—	—	
	3·7700	1·7661	1·1880	0·6294	24·056

Salt lakes though not so numerous as fresh-water lakes, occur in large numbers in certain regions. The Caspian Sea with an area as large as Spain, the Sea of Aral, and a vast number among the mountains and table-lands north of the Himalaya; the Dead Sea in Syria; L. Utah, and neighbouring lakes among the mountains on the western side of North America; and among the mountains of South America and in the interior of Australia are examples of large salt water lakes. It will be noticed that all these lakes lie in an area of inland drainage, that they have rivers running into them, but that they have no outlet. On inspecting the above table it will be seen that the Black Sea is fresher than the Mediterranean, by reason of the greater supply of fresh water furnished by the rivers, and Edward Forbes showed that this freshening has caused certain of the shells of Mediterranean species to assume "monstrous" shapes. The Caspian is still fresher, and its fauna and fossils in recent deposits in the neighbourhood prove it to have once had connection with the Black Sea, from which it has been separated by changes in physical geography; it was then salter than at present, but is now growing salter again every year, and the fauna now inhabiting its waters have likewise considerable affinities with North Sea types. Its surface level is 83·5 ft. below that of the Black Sea, while the surface of the Dead Sea is 1300 ft. below that of the Mediterranean. In all cases where rivers flow into depressions in the land, however these might have been formed (oscillating movements of the earth's crust might perhaps form such large ones as the Caspian basin), carrying with them certain salts in solution, if the lake have no outflowing river, the water must be carried away by evaporation, in which case the salts will be left behind, and the remaining waters become more and more saturated. It is stated that crystals of salt have been brought up from the Dead Sea, and on the shallow waters on its coasts evaporating in summer saline incrustations are left. The same water which flows *through* the Sea of Galilee, a fresh-water lake, renders the Dead Sea one of the most remarkable salt lakes in the world. And in this and all similar cases accumulation of salts will go on till the saturation point is reached, and then precipitation will commence. The region to the north of the Himalayas is comparatively rainless, owing to the mountains condensing the moisture carried by the south winds, and the rivers consequently do not carry into the lakes sufficient water to make them overflow their boundaries, hence they are salt. Lake Baikal, with an outlet to the sea, is quite fresh. For a similar reason the moisture from the south-west winds being condensed in great part by the Sierra Nevada, the lakes which lie in the great plains and table-lands to the east of that range have not a sufficient supply of water to cause them to overflow, and consequently they are salt, and are continually becoming salter. In 100 parts by weight of the water of the Great Salt Lake in that region, there are of chloride of sodium (common salt) 20·196; sulphate of soda 1·834; chloride of magnesia 0·252; chloride of calcium a trace, making a total of 22·282. And by means of the old water levels in the form of terraces round its margin, it can be proved that it has shrunk very considerably, and therefore its salts must be becoming very much concentrated. On the surrounding plains a saline efflorescence is found, which the lecturer believed might be explained by the rain which saturated the rocks during the rainy season rising again to the surface charged with salts dissolved from the rocks, during the intense heats of summer.

(*To be continued*).

SCIENTIFIC SERIALS

The *Zoologist* for January and February contains reviews of the works of Capt. Shelley and the late C. J. Andersson. Dr. Gray contributes a paper on the Cetacea of the British Seas, and Mr. Harting has a supplement to his paper on the British Heronries, a subject on which there are several letters also published. Messrs. Stevenson and J. H. Gurney, jun., send Ornithological notes from Norfolk, and Messrs. Gatcombe and Cordeux from Devon and Lincolnshire respectively.

The *Entomologist* for January and February, among other articles of interest, contains one by Mr. H. C. Lord, on "The Lepidoptera of Switzerland," as far as could be obtained in a twelve days stay. Out of the sixty-three species of butterflies met with, twenty-four are not British. Many of the English commonest forms are among the most frequently found there. *Colias Hyale* is commoner in some parts than *C. Edusa*, and *C. Helice* is not unfrequently found. Mr. F. Walker continues his papers on "Economy of Chalcidiæ."

SOCIETIES AND ACADEMIES

London

Royal Society, Jan. 9.—"On a new Method of viewing the Chromosphere," by J. N. Lockyer, F.R.S., and G. M. Seabroke.

The observations made by slitless spectroscopes during the eclipse of December 11, 1871, led one of us early this year to the conclusion that the most convenient and labour-saving contrivance for the daily observation of the chromosphere would be to photograph daily the image of a ring-slit, which should be coincident with an image of the chromosphere itself.

The same idea has since occurred to the other.

We therefore beg leave to send in a joint communication to the Royal Society on the subject, showing the manner in which this kind of observation can be carried out, remarking that, although the method still requires some instrumental details, which will make its working more perfect, images of the chromosphere, almost in its entirety, have already been seen on several days during the present month and the latter part of last month.

The adaptation of this method to a telespectroscope will be seen at a glance from the accompanying drawing.

The image of the sun is brought to focus on a diaphragm having a circular disc of brass (in the centre) of the same size as the sun's image, so that the sun's light is obstructed and the chromospheric light is allowed to pass. The chromosphere is afterwards brought to a focus again at the position usually occupied by the slit of the spectroscope; and in the eye-piece is seen the chromosphere in circles corresponding to the "C" or other lines. The lens D is used to reduce the size of the sun's image, and keep it of the same size as the diaphragm at different times of the year; and the lenses F are used in order to reduce the size of the annulus of light to about $\frac{1}{8}$ inch, so that the pencils of light from either side of the annulus may not be too

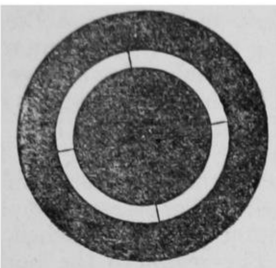


FIG. 1.

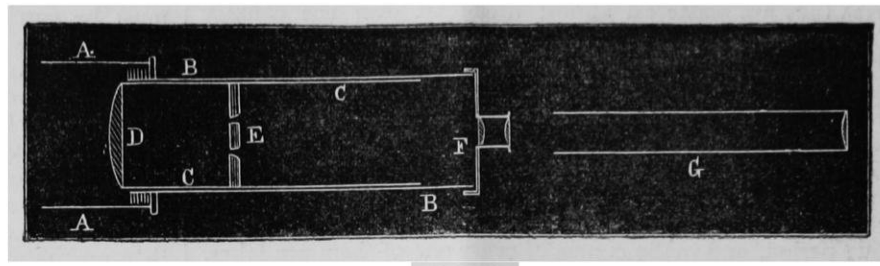


FIG. 2.

Fig. 1.—Diaphragm showing annulus, the breadth of which may be varied to suit the state of the air. The annulus is viewed and brought to focus by looking through apertures in the side of the tubes.—Fig. 2. A. Sliding eye-tube of telescope. B. Tube screwing into eye-tube. C. Tube sliding inside B, and carrying lens D and diaphragm E. F. Lenses bringing image of diaphragm to a focus at the place generally occupied by the slit of the spectroscope. G. Collimator of spectroscope.

divergent to pass through the prisms at the same time, and that the image of the whole annulus may be seen at once. There are mechanical difficulties in producing a perfect annulus of the required size, so one $\frac{1}{2}$ inch in diameter is used, and can be reduced virtually to any size at pleasure.

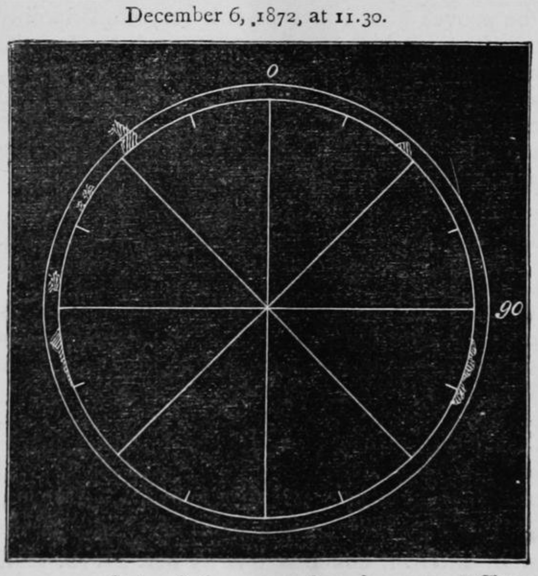
The proposed photographic arrangements are as follows:

A large Steinheil spectroscope is used, its usual slit being replaced by the ring one.

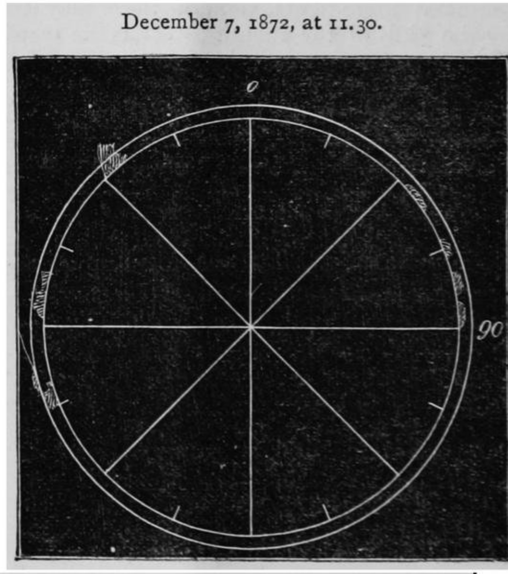
A solar beam is thrown along the axis of the collimator by a heliostat, and the sun's image is brought to focus on the ring-slit by a $3\frac{3}{4}$-inch object-glass, the solar image being made to fit the slit by a suitable lens.

By this method the image of the chromosphere received on the photographic plate can be obtained of a convenient size, as a telescope of any dimensions may be used for focussing the parallel beam which passes through the prisms on to the plate.

December 6, 1872, at 11.30.



December 7, 1872, at 11.30.



Outer circle 100 sec. from inner one. Chromosphere at normal height, except where prominences marked.

The size of the image of the chromosphere obtained by the method adopted will be seen from the accompanying photograph, taken when the ring-slit was illuminated with the vapours of copper and cadmium.

As this photograph is not reproduced, it may be stated that the ring-images have an internal diameter of nearly $\frac{3}{4}$ of an inch.

The accompanying solar profiles are copies of drawing made, on the dates stated, by means of the new method, which were exhibited by the authors at the meeting.

[Since reading the above paper it has come to our knowledge that Zöllner had conceived the same idea unknown to us, but had rejected it. Prof. Wenlock in America has tried a similar arrangement, but without success.—J.N.L., G.M.S., January 17, 1873.]

Feb. 13.—"On a new Relation between Heat and Electricity," by Frederick Guthrie.

It is found that the reaction between an electrified body and a neighbouring neutral one, whereby the eletricity in the neutral body is inductively decomposed and attraction produced, undergoes a modification when the neutral body is considerably heated.

Under many circumstances it is found that the electrified body is rapidly and completely discharged. The action of discharge is shown to depend mainly upon the following conditions:—(1) The temperature of the discharging body and its distance from the electrified one. (2) The nature (+ or −) of the latter's electricity.

With regard to (1), it is shown that the discharging power of a hot body diminishes with its distance and increases with its temperature. But, concerning the temperature, it is proved that the discharging power of a hot body does not depend upon the quantity of heat radiated from it to the electrified body, but chiefly upon its quality. Thus a white hot platinum wire connected with the earth may exercise an indefinitely greater discharging power, at the same distance, than a large mass of iron at 100° C., though the latter may impart more heat to the electrified body.

Neither the mere reception of heat, however intense, by the electrified body, unless the latter have such small capacity as to be itself intensely heated, discharges the electricity if the source of heat be distant: nor is discharge effected when the electrified body and a neighbouring cold one are surrounded by air through which intense heat is passing. But, for the discharge, it is necessary that heat of intensity pass to the electrified body from a neutral body, within inductive range.

White- and red-hot metallic neutral bodies exercise this discharging power even when isolated from the earth, but always with less facility than when earth-connected.

The hotter the discharging body, whether isolated or earth-connected, the more nearly alike do + or – electricities behave in being discharged ; but at certain temperatures distinct differences are noticed. The — electricity, in all cases of difference, is discharged with greater facility than the +.

Attempts are made to measure the critical temperatures at which earth-connected hot iron (1) discharges + and — electricity with nearly the same facility, (2) begins, as it cools, to show a preferential power of discharging —, and (3) ceases to discharge —. The temperatures so obtained are measured by the number of heat-units, measured from 0° C. in 1 grm. of iron of the respective temperature, represented by the value of the expression $Fe\ \Sigma_0 u$.

It is shown that various flames, both earth-connected and isolated, have an exceedingly great power of discharging both kinds of electricity.

The effects in regard to discharge are shown to be similar when platinum wire, rendered hot by a galvanic current, is used, and also when the condensed electricity of a Leyden jar is experimented on.

As hot iron shows a preferential power of discharging — over + electricity, so it is found that white-hot but isolated iron refuses to be charged either with + or — electricity. As the iron cools it acquires first the power of receiving — and afterwards of receiving + Further, while white-hot iron in contact with an electrified body prevents that body from retaining a charge of either kind of electricity, as it cools it permits a + charge to be received, and subsequently a — one.

A suggestion is made as to the existence of an electrical coercitive force, the presence of which, together with its diminution by heat would explain much of what has been described.

"On Curvature and Orthogonal Surfaces." By A. Cayley, F.R.S., Sadlerian Professor of Mathematics in the University of Cambridge.

Entomological Society.—February 3.—H. W. Bates, vice-president, in the chair.—Mr. F. Smith exhibited a box of Hymenoptera, collected near Calcutta, containing, amongst other insects, a new species of *Astata*, and four or five beautiful species of the genus *Nomia*.—Mr. McLachlan exhibited a quadrangular case formed by the larva of a trichopterous insect, taken by the Rev. A. E. Eaton in the river Dove in Derbyshire.—Mr. Champion exhibited specimens of a large species of *Pulex* found in a mouse's nest in Sheppy.—Mr. Meldola exhibited a living specimen of a myriapod of the genus *Spirobolus*, sent to him from San Francisco. Also eggs of a leaf insect from Java (*Phyllium pulchrifolium*).—Mr. Müller made remarks on pouch galls found on the leaves of cinnamon from Bombay.—Rev. Mr. Eaton read a paper on the *Hydroptilidæ*, a trichopterous family.—Mr. A. G. Butler communicated a monograph of the genus *Gasteracantha*, or crab-spiders.

Royal Microscopical Society, Feb. 5, Anniversary Meeting.—W. Kitchen Parker, F.R.S., in the chair. The report and treasurer's statement of account having been presented the president read a highly interesting address descriptive of his own further researches upon cranial development, which, during the year, had been chiefly confined to the formation of the skull of the pig. He briefly indicated the methods adopted, and some of the results obtained, and concluded by expressing the opinion that what he had already observed led him to conclude that if all existing forms had been really derived from one, the process must have been slow indeed. The report having been adopted, and some discussion having taken place as to the society's position, cordial votes of thanks to the retiring president, hon. secretary, and to the other officers of the society for their services during the past year were unanimously carried. The following is a list of the officers and council for the ensuing year :—President--Charles Brooke, M.A., F.R.S. Vice-Presidents—William B. Carpenter, M.D., F.R.S. ; Sir John Lubbock, Bart., M.P., F.R.S. ; William Kitchen Parker, F.R.S. ; Francis H. Wenham, C.E. Treasurer John Ware Stephenson, F.R.A.S. Secretaries--Henry J. Slack, F.G.S. ; Charles Stewart, F L.S. Council—James Bell, F.C.S. ; John Berney ; Robert Braithwaite, M.D., F.L.S. ; William J. Gray, M.D. ; Henry Lawson, M.D. ; Benjamin T. Lowne, F.L.S. ; Samuel J. McIntire ; John Millar, F.L.S. ; Henry Perigal, F.R.A.S. ; Alfred Sanders ; Charles Tyler, F.L.S. ; Thomas C. White. Assistant Secretary--Walter W. Reeves.

MANCHESTER

Literary and Philosophical Society, Feb. 4.—Dr. J. P. Joule, F.R.S., &c., president, in the chair. E. W. Binney, F.R.S., paid a warm tribute to the memory of one of the most illustrious honorary members of the Society, the late Professor Sedgwick.—Prof. Williamson, F.R.S., stated that the second fossil plant described by Mr. Binney at the last meeting of the Society, Jan. 21, and of which a notice appeared in the Society's Proceedings, does not belong to some new genus, as Mr. Binney supposed, but is one that he has already described on two or three occasions as being the stem or branch of the well-known genus *Asterophyllites*. The author said that he had obtained the plant in almost every stage of its growth, from the youngest twig to the more matured stem, and that the genus would be the subject of his next, or fifth, of the series of memoirs now in course of publication by the Royal Society.—"On a large meteor seen on Feb. 3, 1873, at 10 P.M.," by Prof. Osborne Reynolds,* On Feb. 3, at 10h. 7m. (as afterwards appeared) by my watch (which was 7 minutes fast), I was walking from Manchester along the east side of the Oxford Road (which there runs 30° to the east of south), I had just reached the corner of Grafton-street, when I saw a most brilliant meteor. I first became aware of it from the brightness of the wall on my left, *i.e.*, on the north-east, which caused me to turn my head in that the wrong, direction ; the first effect was that of a flash of lightning, but it continued and increased until it was equal to daylight. On lifting my head I saw directly in front of me, what had previously been hidden by the brim of my hat, a bright object, apparently fixed in the sky, as though it were coming directly towards me ; immediately afterwards it turned to the west, and passed just under the moon (which it completely outshone). I was very much startled when I first caught sight of it, owing doubtless to the rapidity with which it was increasing in size, and the directness with which it seemed to be coming. The next instant I saw that it was only an extraordinary meteor. It passed the moon, falling at an angle of, I should say, 20°, and then ceased suddenly, having traversed a path of about 90°, from the south to the east. The colour of the light was that of a blue light, or rather burning magnesium. The sky was cloudy, but there was no appearance of redness about either the head or the train. I endeavoured to fix its course by the stars, but it was too cloudy, although I could see here and there a star. The conclusions I came to, there and then, were that its course must have been nearly parallel with the road, which by the map runs, at that point, 30° to the west of north ; that when I first saw it it was about 40° above the horizon and due south ; and that it passed about 20° to the north of the moon. (This would make its line of approach from Pegasus.) While I was thinking of its course I heard a report, not very loud, but which I connected with it. I judged it was about 30^s after the display. I then looked at may watch ; it was 10h. 7m. I then walked along, talking to a fellow-traveller who had not quite recovered his alarm. Presently we heard a loud report, like a short peal of thunder or the firing of a large cannon ; I immediately looked at my watch, it was then 10h. 10m., so that this second report was from three to four minutes after the display. I have no doubt that this was the report of the meteor, for compared with the other it was like the firing of a cannon to a musket. The time of the second report would make the distance 30 or 40 miles, so that it would have passed over Chester and burst over Liverpool. In this case it must have been a tremendous affair, for the sky was cloudy, and I do not think I exaggerate when I say that at one instant it was as light as day ; the train was very long, and the speed great. It ceased suddenly, as when a ball from a Roman candle falls into water ; there were no fragments, as from an explosion.—"Note on a Meta-Vanadic Acid," by Dr. B. W Gerland.—Dr. Roberts spoke on the subject of Biogenesis. (See his letter in this week's NATURE).—P.S To Dr. Joule's description of a Mercurial Air-Pump.—The exhauster described in the last number (p. 296) has been further improved by dispensing with the glass tube *c*, and its stop-cock *f*. This is effected by attaching the base of the globe *b* to a strengthened india-rubber pipe, connected at the other end to a glass vessel of rather larger capacity than *b*. This vessel has only to be successively raised and lowered in order to exhaust the receiver. The mercury in the vessel may be either under atmospheric pressure or

* See NATURE, Feb. 6, p. 262, and Feb. 13, p. 290.

relieved therefrom. In the former case it must be alternately raised and depressed from 30 inches below *b* up to that level. In the latter it must be raised and depressed from the level of *b* to 30 inches above it. Castor oil is a useful medium to prevent the passage of air between mercury and the glass vessels. It is important to add a little sulphuric acid to the mercury, in order to remove the film of water which adheres to the inside of the globe *b*. On this account it would, perhaps, be desirable to substitute a plug of glass for the indiarubber one between *a* and *b*.

Paris

Academy of Sciences, Feb. 10.—M. de Quatrefages, president, in the chair. M. Faye read an answer to Fathers Secchi and Tacchini's criticism on his recent paper on the solar spots. With regard to the assertion of the former that the gyratory motion of solar cyclones must be small, he replied by proving that it must be at least five times that of the most violent terrestrial cyclones; he then proceeded to answer the other objections in detail, and quoted a recent letter from Mr. Norman Lockyer, in opposition to the Rev. Father's theory of the spots being eruptions. MM. Becquerel and E. Becquerel then read a note on the temperature of soils, bare, and covered with vegetation, during rainy seasons. The bare soils are always at a lower temperature.—M. Daubrée read a note on two meteorites which fell, one at Montlivant in 1838, and the other at Beust in 1859, and also a communication on a new arrangement of the meteorite collection in the Museum d'Histoire Naturelle.—M. des Cloiseaux read a note on the determination of the form of amblygonite crystals; and M. Trécul the third part of his paper on the carpellary theory of the *Papaveraceæ* (*Chelidonium Macleya*), and on the same subject as regards the *Fossiflora Laudoni*. These papers were followed by one by M. de Caligny on certain works used in canal navigation. Notes on vine sickness and Phylloxera were received from MM. Marès, de Luca, Fancon, Nourrigat, Jeanheury, and Madame Vivien Jaworsta. A letter from M. Is. Pierre on the density of absolutely pure alcohol was read.—M. Janssen was then elected to the astronomical section in succession to the late M. Laugier. Out of fifty-six votes he obtained forty-two, M. Loewy thirteen, and M. Wolff one. M. A. Cornu read a paper on a new determination of the velocity of light. His determinations agree well with those of Foucault.—A note on the electric resistance of metals was then read.—M. V de Luynes sent a note on the annealing of glass.—MM. Rabuteau and Ducoudray one on the toxic properties of calcic salts. The authors state that metals are more poisonous as their atomic weights increase, and compare calcium with strontium and barium, both of which are poisonous to a considerable extent.—M. F. Papillon sent a second note on experimental researches on the modification of the composition of bone.—M. Champouillon one on the properties of silicate of soda, &c.—M. S. de Luca one on a stalagmitic body from the solfaterra of Pozzuoli.—Messrs. Lockyer and Seabroke sent a description of their method of observing the solar prominences with an annular slit; this was followed by a paper on the "Heat of Transformation," by M. J. Moutier; and one on the maximum resistance of galvanometers, by M. Th. du Moncel.—MM. Laussedat and Magnin sent a note on the use of the pocket aneroid and on a new hypsometric formula of great simplicity.—M. E. Bourgoin sent a paper on the action of bromine on di-bromosuccinic acid. The author has thus obtained a hydride of tetra-brominated ethylene.—M. F Hamel sent a note on a new red colouring matter from aniline. The body in question is produced by acting on aniline with chloride of sulphur.—M. J. Carlet sent a description of a new osmometer.—M. Locari sent a paper on the presence of human bones in the osseous brecchia of Corsica; and M. E. T. Hamy one on the age of the fossil men of Guadeloup.—M. W de Fonvielle sent a description of a new lightning conductor. The session then adjourned.

DIARY

THURSDAY, February 20.

Royal Society, at 8.30.—On the Anatomy and Histology of the Land Planarians of Ceylon: H. W. Moseley. On a new Locality of Amblygonite, and on Montebrasite, a new Hydrated Aluminium and Lithium Phosphate: A. O. Des Cloizeaux.

Society of Antiquaries, at 8.30. Memoir and Funeral Expenses of James Montagu, Bishop of Winchester, A.D. 1618: E. P Shirley.

Linnean Society at 8.

Chemical Society, at 8.—On Aurin: R. S. Dale and Dr. C. Schorlemmer—Researches on the Action of the Copper Zinc Couple on Organic Bodies.—I On Iodide of Ethyl: Dr Gladstone and A Tribe.—Solidification of Nitrous Oxide: Mr. Wills.—Action of Hydrochloric Acid on Codeine: Dr. C. R. A. Wright.

Numismatic Society, at 7.

Zoological Society, at 4.

FRIDAY, February 21.

Geological Society, at 8.—Anniversary.

Royal Institution, at 9.—Action at a Distance: Prof. Clerk Maxwell.

Royal College of Surgeons, at 4.—Extinct Mammals (Hunterian Lectures): Prof. Flower.

Old Change Microscopical Society, at 5.30.—On the Internal Economy of Insects: T. Rymer Jones.

SATURDAY, February 22.

Royal Institution, at 3.—Comparative Politics: Dr. E. A. Freeman.

SUNDAY, February 23.

Sunday Lecture Society, at 4.—The Skin; its Structure and Uses: A. Balmanno Squire.

MONDAY February 24.

Royal Geographical Society, at 8 30.—A Journey in Southern Formosa J. Thomson.—Notes on Badakhshan and Waknan: The President.

London Institution, at 4.—Physical Geography: Prof. Duncan.

Royal College of Surgeons, at 4.—Extinct Mammals: Prof. Flower

TUESDAY February 25.

Royal Institution, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, February 26.

London Institution, at 7.—Lecture.

Royal College of Surgeons, at 4.—Extinct Mammals: Prof. Flower.

Society of Arts, at 8.—Discussion on Lieut.-Col. A. Strange' Paper on "Ships for the Channel Passage."

Geological Society, at 8.—On the Jurassic Rocks of Skye and Raasay: Dr. James Bryce.—Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders: D. Mackintosh.—On the Origin of Clay-ironstone: J. Lucas.

Archæological Association, at 8.

Royal Society of Literature, at 8.30.—Remarks on Early Monastic and other Seals attached to Charters in the Bodleian Library, Oxford: W. H. Turner.

THURSDAY, February 27.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30

Royal Institution, at 3.—Artificial Formation of Organic Substances: Dr. Armstrong.

BOOKS RECEIVED

English.—Elementary Anatomy: St. G. Mivart (Macmillan).—Caliban the Missing Link: Dr. Wilson (Macmillan).—Recent Discussions in Science, Philosophy, and Morals: new edition: H. Spencer.—Science Primer, No. 4, Physical Geography: A. Geikie (Macmillan).—Key to North American Birds: E. Coues (Trübner). Exalted state of the Nervous System: R. H. Collyer (Renshaw).

American.—What am I? Vol. i.: E W. Cox (Appleton, New York).

Foreign.—Anwendung des Spectral appartus: Dr. K. Vurdott (Asher).

PAMPHLETS RECEIVED

English.—Annual of the Royal School of Naval Architecture, No. 3, Jan. 1873.—Physical Condition of the Inland Seas.—Report of the Scientific Researches carried on during the months of Aug., Sept., Oct., 1871, in H.M. Surveying Ship *Shearwater*: W. B. Carpenter.—Science and Art Dept.: Babbage Calculating Machine.

Foreign.—Sitzung-Berichte Nat. Gel. Isis, Dresden, April to September 1872.

CONTENTS

Errata.—Vol. vii p. 280, 1st col. 3rd line from bottom, after *Myxospongiæ*, insert *and Hydrozoa*: p. 289, 1st col., line 17 from bottom, for *hematoids* read *Nematoids*: p. 289, 1st col., line 11 from bottom, for ·175 read $\frac{1}{8}$th: p. 291, 1st col. line 4 from top, for *leucocyles* read *leucocytes*.