THURSDAY, SEPTEMBER 5, 1872

NAVAL SCIENCE *

MR. REED, who has hitherto been known to the naval world principally as a successful ship-builder, and as the writer of two valuable works on ship-building, comes before it now in the additional character of editor of a magazine, which, under the title of *Naval Science*, professes to embrace all branches of science relating to naval affairs. How far this profession will be fulfilled, as the magazine, advancing from number to number, gathers strength with increasing age, remains to be seen; but at present it is impossible to avoid the remark that a very disproportionate part of the two numbers now before us, and more especially of the first, is occupied with articles devoted to the study of naval architecture. The superabundance of papers relating to this subject is one which, from Mr. Reed's antecedents, might fairly have been expected, and is to be expected in the earlier numbers, until the editor gathers round him a staff competent to write on the many other scientific topics which present, or should present, equal interest to, and as directly concern, our naval officers. Such subjects as the stability or the rolling of ships, ably and in most respects agreeably as they are treated, have, from their theoretical point of view, absolutely no connection with the duties of a naval officer, however much they may appeal to his desire to be fully acquainted with whatever bears, even remotely, on his profession. It is, of course, important that, with these new ships which have points of maximum and vanishing stability, the commanding officer, and not only he, but every executive officer, should familiarly know the limit of inclination which his ship must never be allowed to exceed; but, practically speaking, it is of no more consequence to him to know the mathematical reason of this than it is to know the geological formation of a submerged rock ahead. The relation between the period of a ship in the trough of the sea and the period of the waves amid which she would be rolling, has even still less to do with the practical duties of a seaman who is unable, under any circumstances or in any degree, to alter either "the metacentric height," "the radius of gyration," or "the period of oscillation" (p. 199); but who is able, so long as the ship is not a helpless wreck, to keep her out of the trough of the sea, the position to which these experiments and calculations refer. We by no means wish to imply that the study of such questions as these is of no importance to the naval officer; on the contrary, we are very decidedly of opinion that whatever gives him a clearer insight into the meaning of the rules by which his conduct has to be guided, renders him a more intelligent, and therefore a more capable officer; what we would say is, merely, that they have not such paramount interest as to render it desirable to devote to them at least half the space in a magazine of Naval Science. Saying this, we must also add that we are fortunate in having in Mr. Reed one who represents for one scientific branch what should be represented in all branches.

The remaining space has been allotted to more varied papers, some of which are of considerable ability. Amongst these we would specially mention one on "Naval Tactics," which contains a very interesting *résumé* of the subject, and permits us to hope that in a future number the writer will enter more fully into a discussion of the probable and possible effects of the several formations; for though no certain result can be arrived at till war has actually tested them, it seems to us that much knowledge may be gained by a consideration of the different methods of attack and defence, as opposed to each other.

We have, again, a valuable contribution to navigation in an article on "Rhumb and Great Circle Charts," which illustrates the important application of the Great Circle principle to windward sailing, in a manner more lucid and satisfactory than we remember to have seen in print before. But in treating of its more general relations to navigation and to the conduct of a long passage, the writer would seem to have momentarily overlooked the geographical as well as the meteorological constraints which are everywhere put on it; thus, for instance, in the outward passage to Australia, the great circle route leads through latitudes dangerous or impassable from ice, whilst the steadiest streak of westerly winds is to the north rather than to the south of the 45th parallel. A previous article from, if we mistake not, the same pen, enters on the long-vexed question of "The Rational Method of Teaching Navigation." There can be little doubt that the author is right as to the rationality of the method;—as to the utter irrationality of the method which has been hitherto generally adopted, the difficulty which has stood in its way has been the absolute impossibility of adapting it to the necessities of the service, and of giving very young boys the requisite grounding in elementary mathematics, in the given time and amid the bustle and disturbance of a sea life. We may fairly hope that this difficulty is about to vanish, now that Mr. Goschen recognises the advisability of materially increasing the age for the entry of naval cadets. It is on this that the hope of any real improvement in the state of naval education must principally depend. When a youngster at the age of fourteen is thrust into a world of peculiar hardship and excitement, he must have an extraordinary aptitude if he follows up book-learning one step more than he is obliged to do. It appears in the evidence before Admiral Shadwell's Committee that about seven hours a week is a good average amount of study under instruction; it does not appear in the evidence, but it is none the less true, that a young boy's attendance at study in the forenoon, after he has kept the morning or middle watch, is for the most part corporeal rather than mental, from which he derives little or no profit. When the present system has been entirely done away with, and been replaced by some other, such, perhaps, as that recently proposed by Captain Goodenough, we may hope that our young naval officers, as they grow into manhood, may possess a fair groundwork of the more essential parts of an exact education. But until some such radical alteration has been made, until a real, however moderate, amount of accurate grounding becomes the rule and not the exception amongst our young officers,

* "Naval Science: a Quarterly Magazine for Promoting the Improvement of Naval Architecture, Marine Engineering, Steam Navigation, and Seamanship." Edited by E. J. Reed, C.B., &c. Nos. I. and II., 8vo. Lockwood & Co.)

we confess that we can scarcely look with confidence to the now loudly vaunted schemes for "the higher education of the navy," whether it is to be carried on at Greenwich or elsewhere.

It is, however, a mistake to speak, as is so commonly done, of the navy as a scientific profession. As a profession, the regular line of the service is practical amongst the practical; it requires and cultivates a quick eye, a restrained temper, a cool courage, a ready judgment of men and things; it calls for a minute and thorough knowledge, not only of all that relates to the management of ships and men, but of the extensive "literature" issued and demanded by the Admiralty; few have the time, even if they had the disposition, to go deep into scientific study, to which there is no inducement, for which there is no reward. One of the earlier articles in the magazine before us, "On the Necessity of forming a Naval Staff," pointedly calls attention to this. We believe that the writer has under rather than overstated his case. That beyond the regular line of the service there are duties which call for a higher and more extended knowledge, is freely admitted by all; and we are convinced that these duties will be more efficiently performed by officers specially educated for them, than by others nominated indiscriminately or by roster, after a vain endeavour to bring the whole body of officers to one universal high standard. There are few men, worth anything at all, who have not a distinct speciality, and we conceive that it is by allowing, nay, encouraging these specialities to develop themselves to the utmost, that the greatest perfection in the aggregate is to be attained. To force a man of an essentially practical turn of mind, with a judgment in the handling of a ship, or with an insight into the character of men, which seems instinctive rather than acquired, to go through a distasteful course of high mathematics, or of foreign languages, or, on the other hand, to pin a man of unusual taste and aptitude for the study of more advanced science down to the routine of the service, appears to us a most erroneous system. Yet, so far as we understand, this is what is seriously proposed. The formation of a Naval Staff, and the abolition of the existing segregation of navigating officers, would, we believe, be a radical and immediate cure. It is in evidence before the committee already referred to, that the special training of officers whom interest or taste attracts to gunnery duties, has been found to work exceedingly well; we believe that a similar system with regard to navigating duties would be as successful; nor can we admit that a small body of men, chosen by the mere accidents of birth or family connection, is likely to furnish such a number of first-rate navigators and surveyors as could be got together by special selection from the whole service;—to use a geographical simile, we would drain a larger area. Roughly speaking, about one-sixth of the lieutenants on the list have taken out gunnery certificates; the proportion of those who would take out advanced certificates in navigation would probably be considerably greater; whilst, indirectly, a large number would follow up some course of study with a view to turning it to future account. If appointments as flag-lieutenants were made in a similar way, we believe that the impetus given to study amongst the officers of our navy would lead to results quite equal to those wished for. But it is not in human nature to pursue a course of study wearisome in its beginnings, amidst the worry and turmoil of an active profession, without encouragement, without hope of reward.

We have no space to notice, in a manner proportionate to its merits, Mr. Mallet's article on the Action of Torpedoes; this, after all, is, so far as the navy is concerned, the question of the day, and any discussion that leads to a closer acquaintance with it ought to be carefully studied. Every one acknowledges, first, that the navy, at present, is in a transition state; and secondly, that more Science is wanted. We consider it a fortunate thing, therefore, that what is destined to be a high-class journal of Naval Science, under the editorship of such a distinguished man as Mr. Reed, has made its appearance at this time, and we wish it every success—a success, moreover, which is certain, so long as the stated point of view is steadily kept in mind.

OUR BOOK SHELF

Die Echinoiden der oesterreichisch-ungarischen oberen Tertiärablagerungen. Von Dr. Gustav C. Laube. Mit vier lithographirten Tafeln. (Wien, 1871.)

AGASSIZ, Desor, E. Forbes, Desmoulins, and Wright have written elaborate monographs and descriptions of Miocene Echinodermata. Prof. Ed. Forbes described (Proc. Geol. Soc., vol. iv. pp. 230-232, 1843) a large series from the miocene beds of Malta and Gozo, collected by Capt. Spratt, R.N., of H.M. surveying vessel *Beacon;* Dr. Wright in 1855 (Ann. Mag. Nat. Hist., vol. xv.) described many species from collections made by the Earl of Ducie, from the same islands; and again, in 1864 (Q. Jour. Geol. Soc., vol. xx. p. 470), through the series collected by Dr. Leith Adams at Malta, he described new miocene forms. These were all important additions to the then little known echinodermata of the miocene rocks of southern Europe. In the present monograph, which is reprinted from the "Abhandlungen der k. k. Geologischen Reichsanstalt," Dr. Gustav C. Laube also carefully describes fourteen new or previously unknown species of echinoderms from the Austro-Hungarian miocene (upper tertiary) deposits, and adds a new genus (*Brissomorpha*) to receive those forms possessing non-depressed ambulacral grooves, and an attenuated posterior border. Many of the species described by Laube are peculiar to the miocene rocks of the Austro-Hungarian area, whilst others have a much wider distribution, several being identical with the Maltese forms described by Dr. Wright. Of the fourteen genera and thirty-seven species included in Dr. G. Laube's monograph, seven species occur in Malta, seven in Corsica, and eleven in France; while the remaining twelve species are peculiar to the Austro-Hungarian beds. The following new species have been described and figured by the author in the memoir before us, viz., *Cidaris Schwabenarii*, *Echinus dux*, *E. hungaricus*, *Echinocyamus transylvanicus*, *Scutella Vindobonensis*, *Echinolampas angustistellatus*, *Pericosmus affinis*, *Hemiaster rotundus*, *H. kalksburgensis*, *Schizaster leithanus*, *S. Karreri*, *Brissomorpha Fuchsi*, *Spatangus euglyphus*, and *S. austriacus*. The monograph contains a very valuable table showing the distribution of those species which occur elsewhere, such as Malta, Corsica, Italy, and France, with a general column for other localities (*andere Länder*); it is accompanied by four quarto lithographic plates devoted to the local and new species, which are carefully figured. The whole is an important contribution to this division of the *Annuloida*. R. E.

Fishes of New Zealand. Catalogue, with Diagnoses of the Species. By F. W. Hutton, F.G.S., Assistant Geologist. *Notes on the Edible Fishes.* By James Hector, M.D., F.R.S., Director. With 12 plates. (New Zealand, Wellington, 1872.)

THE geologists of New Zealand are of opinion that, in order to acquire a knowledge of the inhabitants of their country in past epochs, it is necessary first to know what its present inhabitants are. This will appear rather strange to some of their European brethren, who do not seem to consider that the subjects have anything to do with one another, and who usually keep them as far apart as possible. But there can be no doubt, we believe, that our Antipodal friends are right, and that a knowledge of the extinct fauna of any country must be preceded by a study of its existent fauna.

We have lately given our readers an account of two lately-published works on the Birds of New Zealand. We have now the pleasure of introducing to their notice an excellent *résumé* of the present state of our knowledge of the fishes of the same country. This has been prepared by Captain Hutton, author of one of the previously mentioned treatises, under the direction of the enlightened Chief of the Geological Survey of New Zealand, who himself contributes additional information to the volume of a highly important nature, in shape of Notes on the Edible Fishes of the Colony.

The arrangements and nomenclature adopted by Capt. Hutton are that of Dr. Günther's "Catalogue of Fishes," the most recent and by far the best authority on the subject. A few new species are introduced, discovered since the issue of Dr. Günther's work, and some imperfectly known fishes mentioned, which Dr. Günther does not appear to have noticed. Thus the total number of New Zealand fishes included in Captain Hutton's work amounts to 141. There can be no doubt, however, that this number will be considerably augmented when more attention has been devoted to the subject. Indeed, we believe that even within the past few months Dr. Günther has described some rather remarkable additions to the Ichthyological Fauna of New Zealand, which are not included in the present synopsis.

The greater number of New Zealand fishes are marine species. The freshwater fish fauna is poor in the extreme, although it included two remarkable forms belonging, one to the true *Salmonidæ*, and the other to a nearly allied group, which are the "Smelt" and "Grayling" of the native fishermen. The former fish, Dr. Hector tells us, is "delicious food," but does not attain sufficient dimensions to make it of great importance as an article of diet. But the native "grayling," which probably reaches 6 lbs. or 8 lbs. in weight, ought to be valuable, and we cannot quite understand why, with such a fish available, it was thought necessary to spend large sums in the endeavour to introduce European *Salmonidæ* into the freshwater of New Zealand.

In concluding the brief notice of a most useful work, we should add that the twelve plates which accompany it, and which give the outline of about fifty of the most characteristic species, even if not of great scientific value, will, we are sure, be of great assistance to the unlearned colonist in his attempt to make out the correct names of the native fishes.

LETTERS TO THE EDITOR

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

Radial Polarisation of the Corona

DURING the recent meeting of the British Association at Brighton, it was casually remarked by Sir William Thomson that during the eclipse of last December, it had been observed that the radial polarisation of the corona was greater at a small distance from the sun than close to it. This observation he thought was a very important one.

My observations on this subject were published in the *Philosophical Magazine* for last March, but I think Sir William Thomson's opinion may be taken as sufficient reason for thinking that they would not be uninteresting to the readers of NATURE.

I have twice accompanied Mr. Pogson, the Government Astronomer at Madras, as polariscopic observer, in his eclipse expeditions; first, in August 1868, and secondly, last December.

In August 1868 I used simply a Savart's polariscope, attached to a telescope, employing a diaphragm to limit the field of view. On this occasion I found that the corona was radially polarised. I shall enter, however, more fully into a description of the method adopted last December, as the results then obtained, while confirming those obtained in 1868, are, I think, of much greater importance.

The Savart was so adjusted as to show a white central band between two dark ones, when the bands corresponded in direction with the plane of polarisation. This polariscope was, last December, converted into a polarimeter, by causing the light to be examined to pass first through four plates of crown glass, mounted in a frame, moveable on an axis at right angles to the direction of the bands. This instrument was fixed in front of the eye-piece of a small equatorially-mounted telescope.

When the glass plates were perpendicular to the optical axis of the instrument, they had, of course, no effect whatever upon the polarisation of the light passing through them; but if the frame carrying the plates were turned on its axis, the light passing through them would be polarised in a plane parallel with the axis, and hence at right angles to the direction of the bands, and the amount of polarisation so caused may be calculated for any angle the glass plates may make with their normal or zero position by means of formulæ in Prof. W. G. Adams's paper, published in the *Philosophical Magazine* for April 1871.

It is evident that if we are examining common light by this instrument, turning the glass plates will cause black centred bands to appear; that is, the central band will be dark, and between two white ones, exactly the reverse of what takes place when light polarised in the plane of the bands is examined by the polariscope. If then while examining light polarised in the plane of the bands, we turn the glass plates, we prevent that polarised light from passing to the polariscope, and the bands gradually disappear as the angle of the plates increases, and they completely disappear when the plates are at such an angle as would produce on ordinary light the same amount of polarisation as that existing in the light under examination.

By knowing the angle through which the plates have to be turned in order to extinguish the bands, we are able to measure the amount of polarisation in any polarised light; the instrument forming what may be called a differential polarimeter. Further, it is evident that if we place our bands at right angles to the plane of polarisation, we shall get black centred bands, which would only be increased in intensity by turning the glass plates; hence we can only measure the polarisation of light with this instrument when the direction of the bands coincides with the plane of polarisation.

My own observations of the eclipse of 1868 led me to expect to find radial polarisation.

Prof. Pickering thought that the polarisation he observed in 1869 was caused by the reflection of sunlight from the unobserved portions of the earth into the atmosphere, and thence back to the eye. The plane of polarisation would, in that case, be vertical near the sun. I took the portion of the limb at about 90° from the vertex, towards the south (that is near the southern limb) for my observations, and carefully placed my instrument so that the bands were radial to the sun before totality. The bands were therefore horizontal, or nearly so. This was then a crucial experiment as to the accuracy of Prof. Pickering's view on the one hand, or of my own previous determination on the other.

Directly totality commenced the bands appeared, and they were white centred. The plane of polarisation was, therefore, horizontal and not vertical; it was radial, and could not be caused in the way imagined by Prof. Pickering.

I next turned the glass plates till the bands disappeared, and by this means measured the amount of polarisation, which as I have before explained, could not be done had the plane of polarisation been at right angles to the plane of the bands.

On examining the light from a portion of the corona at about ten minutes distance from the limb, I found the polarisation

greater, in about the ratio of ·275 to ·158, than it was close to the limb; these figures representing approximately the amount of polarisation respectively at ten minutes from the limb, and close to it, the total light being unity.

We may therefore conclude that

1. The corona is radially polarised.
2. This polarisation increases as we recede from the limb.

The bright lines seen in the spectrum of the corona inform us that *part* of the light we receive from it is intrinsic, that is, that the gases composing it are incandescent, and from their proximity to the sun we should scarcely expect anything else; yet this fact in no way renders it impossible that much of the light we receive from the corona should be reflected or scattered by minute particles of, perhaps, denser matter, probably incipient cloud, suspended within it, as such particles are supposed to exist in the earth's atmosphere, in order to account for the polarisation and blue colour of the sky. This supposition, when we remember that the temperature, and hence the amount of intrinsic light, must decrease as we recede from the sun, would amply account for the increase of polarisation with distance from the limb. There are, however, two other causes which may be named as adequate to produce this effect. Probably in reality the increase is due to the three causes combined.

When the plates were inclined so as to neutralise the corona polarisation, I saw faint dark centred bands on the portion of the moon's disc in the field. I did not observe any when the plates were at right angles to the axis of the telescope, but I think I should have noticed them had they existed; so that although there was a sensible amount of light on the moon's disc sufficient to show bands when polarised by the glass plates, I do not think it was perceptibly polarised itself. This would tend to show that the light was reflected from the moon itself, and not from the intervening atmosphere.

G. K. WINTER

Erratum of the Errata, or, "A Few Millions"

I AM indebted to Mr. A. Cowper Ranyard, of London, for calling public attention to errors existing in the illustrative appendix to a research entitled Acoustical Experiments, &c., which article of mine the Editor of NATURE honoured with a republication in his journal on May 9, 1872.

The existence of these errors has been known to me since a few weeks after the original publication of my paper; but as they did not affect in the least the subject proper of the research, and would be apparent to any one who might take the trouble to review the calculations, I allowed them to pass unnoticed, and even now would not pursue the subject further had Mr. Ranyard really corrected my errors; but he has *himself* committed the error of "A Few Millions" (the title of his communication*) which he would attribute to *me* when, in these words, he undertakes the correction of my figures. "Taking the velocity of light as 185,300 miles per second, and the wave-length of D_1, as given by Angström, at 0·00058950 millimetres, gives 5,058,700,000,000,000 vibrations per second, or a little more than *five thousand millions of millions*, instead of a little less than *six hundred millions of millions* vibrations per second, as given by Dr. Mayer." The following is the correct calculation:—

$$185{,}300 \text{ miles} = \frac{298{,}212{,}000{,}000 \text{ mm.}}{\cdot 0005895 \text{ mm.}} = 505{,}870{,}000{,}000{,}000$$

and 5,058,700,000,000,000 (Mr. A. C. Ranyard's result) minus 505,870,000,000,000 (Mr. Mayer's result) gives Mr. Ranyard 4,552,830,000,000,000 tremors.

Thus it appears that both Mr. Ranyard and myself commit errors in simple arithmetic, but I am sure that our mutual friends will not attribute them to want of sufficient mathematical culture to accomplish "a simple rule-of-three sum." (A. C. R.) He that is without sin let him first cast a stone. I, however, do not wish Mr. Ranyard's errors in any way to extenuate my own greater negligence which has disfigured the appendix of my paper, containing, as it does, "some strange numerical errors, which perhaps it will be well to point out, lest some of your readers should make use of the numbers given at the end of the paper without previously testing them." (A. C. R.) I will therefore ask my readers to substitute for the last paragraph under the heading of "Quantitative Relations in the Experiments and Analogical Facts in the Phenomena of Light," the following:—

"We will now examine the analogical phenomena in the case of light. Let fork No. 1, giving 256 vibrations a second stand for 508,730,000,000,000 vibrations a second, which will be the number of vibrations made by the ray D_1 of the spectrum, if we adopt 300,000 kilometres per second as the velocity of light. Then fork No. 3 will represent 504,750,000,000,000 vibrations per second, which latter give a wave-length ·0000048 millimetre longer than that of D_1, and belongs to a ray removed from D_1, towards the red end of the spectrum, by eight times the distance which separates D_1 from D_2. We saw that fork No. 3, giving 254 vibrations a second, had to move towards the ear with a velocity of 8·734 feet to give the note produced by 256 vibrations per second, emanating from a fixed fork; so, if a star, which only sends forth those rays which vibrate 504,750,000,000,000 times a second, should move towards the eye with a velocity of 2,442 kilometres, or 1,517 miles, its colour would change to that given when D_1 emanates from a stationary soda-flame."

ALFRED M. MAYER

* See NATURE, June 20.

Rev. John Ward on Atmospheric Germs

THIS worthy was Vicar of Stratford-upon-Avon, from 1662 till his death in 1681. He was a man of general knowledge, and was specially skilled in the diseases of women and children. It is not known that he obtained the archiepiscopal licence to practise physic, but he certainly practised the healing art, and he records his intention "to inquire whether a man may get of the archbishop a licence to practise *per totam Angliam!*" His diary, 1648-1679, is sensible and entertaining. It is chiefly known as containing a notice of Shakespeare, with the only extant account of the cause of his death, viz., "a feavour" caused by a carouse with Drayton and Ben Jonson. The Diary is in the Library of the Medical Society of London. It was edited by Dr. Charles Severn, and published by Colburn, in 1839.

The following extract is remarkable:—

"Venenum pestilens est congeries minimarum animalcularum per aerem volitantium, quæ corpora humana per respirationem aut poros subeuntes, eorum partes corrodunt et corrumpunt, ex iisque ad alia corpora volitantes, seu ad alia quocunque modo delatæ, et quasi contagio propagatæ, etram illa inficiunt, corrodunt, corrumpunt, sicut priora, e quibus evenerunt. . . . Supra fœnum cubare noxium multis fecit, non solum in peste, sed etiam in aliis morbis."

Of course *in peste* means "in the case of the plague."

C. M. INGLEBY

Coefficients of the Linear Expansion of Solids

AT the British Association which met last year in Edinburgh I suggested a *thermometer of translation* which should record the amount of the successive rises of temperature during the year. For this purpose a body possessing great expansibility with a fine needle point at its upper end, was proposed to be placed on a sloping frame, and made of a material possessing small expansibility, and protected from the changes of temperature, and having its upper surface finely serrated. When the body expanded, its upper end bearing the needle point would extend higher up on the frame, and when contraction commenced the projecting needle point would continue its hold of the teeth on the frame, preventing shortening at its upper end, so that the centre of gravity of the mass would be raised. In this way the successive increments of heat would be registered by successive *creeps* of the body upwards on the frame.

It has occurred to me that the same principle might be advantageously adopted for measuring the linear expansion of different solids.

In order to double the readings for expansion, clamping screws attached to upright rods fixed at the ends of the body would be better than the needle point for detention during contraction, which was proposed for the thermometer of translation. The bar to be experimented on would be placed on rollers in a vessel containing water or steam of different temperatures. The screws would be tightened at the lower end of the bar, and slackened at the upper before expansion, and tightened at the upper and slackened at the lower before contraction. After the contraction had fully taken place, the bar would be again heated and again cooled, and this process would be repeated until the total amount of translation became easily measurable. Although the amount of translation produced in any case by a single experiment might be scarcely appreciable, yet we can by cumulative repetition increase the amount of translation to any extent without increasing the errors of observation, for a single final reading is sufficient for the whole series of expansions however numerous

they may be. This single reading of the total amount of *creep* being divided by the number of times the experiment was repeated, and by the given number of degrees of heat through which it had been each time successively raised, and by the original length of the bar, will give the desired coefficient of expansion.

I think that results obtained by this mode of translation will, for minute expansions, be more reliable than those obtained either by Lavoisier and Laplace's method, or by that of Roy and Ramsden.

THOMAS STEVENSON

Baden-Baden, August 26

Origin of Insects

IN NATURE of December 7, 1871, there is an interesting letter from Mr. B. T. Lowne, on the Origin of Insects, in which the writer refers to Fritz Müller's "Facts for Darwin" in favour of the opinion that "the larval forms of insects are probably derived from imaginal" or perfect forms. I have not at present any opinion to offer on this subject; but, though I estimate very highly indeed the light which Fritz Müller has thrown on the Crustacea, I think nothing can be more unsatisfactory than his remarks on insects. He concludes that the earliest insects resembled the wingless Blattidæ, overlooking, what is obvious enough, that any theory of the origin of insects ought to account for, or at least show the origin of, those most characteristic organs of the class, the wings. I quite agree with Mr. Lowne that "it is extremely probable that insects first emerged from the water with fully-formed wings." I think it scarcely possible to doubt that the wings were originally organs of aquatic respiration. But this does not answer the question of the origin of insect metamorphoses, which, though an evolutionist, I think one of the greatest difficulties of the theory of evolution; it does not answer the question whether the perfect forms with wings and legs have been derived from the larval forms without either, or the converse.

Mr. Lowne goes on to say, "We have still relics of an aquatic winged insect fauna in the hymenopterous genus, discovered by Sir John Lubbock." I cannot think this brings us any nearer to the origin of insects. It could not do so unless the Hymenoptera were at or near the origin of the class, and this will scarcely be maintained. The Hymenoptera are probably the highest of all insects—certainly so if instinct is the criterion. The aquatic Hymenopteron (I do not know its name) is no more a relic of the origin of insects than are the water-beetles; and no one will say that the Coleoptera are near the origin of the class. It is true that the water-beetles are wingless, while the Hymenopteron in question is winged; but the beetles are a winged order, and those which have no wings have lost them. Indeed, it is only in a functional sense that any beetle is wingless, for they all retain the wing-covers, which are modified wings. It is probably true that the origin of all animals whatever was aquatic, but it does not follow that the aquatic members of any class denote the origin of the class. The aquatic habits and structure may be only adaptive. No one would look to the seal or the hippopotamus for the origin of the Mammalia.

JOSEPH JOHN MURPHY

THE LAW WHICH REGULATES THE FREQUENCY OF THE PULSE

FROM a pamphlet on this subject, recently published by Mr. A. H. Garrod, we extract the following summary of the main features of the circulation:—

"The circulation of the blood is maintained by the repeated contraction of the heart. Each cardiac revolution is divided into three parts—the systole, the diaspasis, and the diastole. The following laws hold with regard to the length of these intervals:—

"I. The systole, together with the diaspasis—or, in other words, the first cardiac interval—varies as the square root of the whole revolution.

"II. The systole varies as the square root of the diastole.

"III. The diaspasis is constant.

"The amount of work that the heart has to perform in maintaining the circulation depends on two sets of changes which may occur in the system: 1. Variations in the blood pressure; 2. Variations in the resistance to the outflow of that fluid from the arteries.

"As the capacity of the arteries, including the ventricles, varies directly as the blood pressure, and as the flow of blood from the capillaries does the same, the frequency of the heart's beats is dependent on the resistance to the capillary outflow, and not at all on the blood pressure; in other words, the heart always recommences to beat when the blood pressure in the systematic arteries has fallen a certain invariable proportion.

"Variations in blood pressure result from: 1. Absorption into, and excretion from, the vascular system of fluids; 2. Changes in the capacity of the arterial system, which occur on the contraction or relaxation of the muscular arteries; 3. Changes in the amount of available blood, which result from the hæmastatic dilitation of some of the yielding vessels on altering the position of the body. As changes in the first of these cannot be very sudden, and those in the latter are never very considerable, the mean blood pressure in health varies but little during short intervals.

"Variations in peripheral resistance result from: 1. Different degrees of tonicity or patency of the muscular arteries; 2. Different resistances in the venous system. The former may occur independently in one or other system of vessels, as the cutaneous or the alimentary; also mechanically from pressure on a part of the body. The latter are insignificant in health.

"The heart depends for its power of doing work on chemical properties in the blood it pumps into the systemic vessels, and as the blood reaches it direct from those vessels, the cardiac intramural circulation varies with the changes in the former; and the length of the systole varying only as the square root of the time of diastole, the degree of cardiac nutrition varies directly as the systematic blood pressure, and as the square root of the diastolic time. The coronary arteries supplying the whole heart, the work done by the right ventricle is governed by that done in the left; thus the supply of blood in the left auricle is always rendered sufficient for the requirements of the systemic circulation; though, as there is no reason for believing that the resistance in the pulmonary vessels varies with that of the systemic, there must be some peculiarities in the former circulation (which may explain the variations in the ratio of the number of pulse beats to respirations in some cases).

"The auricular contraction is a very small force, and its function is most probably to close the tricuspid and mitral valve.

"The heart commencing its systole as a whole, it is highly probable that the impulse for action is given by a force which affects both ventricles; such is found in the coronary circulation and the active diastole produced by means of it."

THE CONGRESS OF PREHISTORIC ARCHÆOLOGY

THE meeting of the International Congress of Archæology at Brussels was brought to a close last Friday, August 30. On the previous Tuesday General Faidherbe spoke on the Dolmens, of which he had made a special study in Algeria. He believes them to be the work of some people whose traces can be found from Pomerania to the coast of Africa, and of whose migrations they indicate the halts. Mr. Franks, of the British Museum, presided on the afternoon of the same day, when the discussion turned chiefly on the primitive races of Belgium. On Wednesday the last expedition of the Congress took place, Namur and the Camp of Hastedon, distant about two kilometres from Namur, being the places selected. The establishment of this camp, covering an area of from eleven to twelve hectares, is attributed to the men of the Polished-Stone period. It is situated on a high plateau, and the cuttings made through the ancient enclosure were explained by M. Dupont, Director of the Brussels Museum.

M. Dupont dwelt chiefly on the fact that at the epoch of the Mammoth there were two perfectly distinct populations in Belgium, one using the flint cut at Spiennes, near Mons, and the other that of the Somme. The highly interesting Museum of Archæology belonging to the town of Namur was afterwards examined by the Congress. At the meeting of Thursday, M. Dupont traced the connection of the various populations in Belgium among each other at the different ages of stone; after which a lively debate arose on the question of the descent of the present race of men from the troglodytes, and on the causes of the difference of types. In the afternoon the problems of the Tertiary age and the age of Bronze occupied the Congress. On Friday morning the question of determining the relative remoteness of the ages of bronze and of iron led to many valuable disquisitions; and Mr. Hyde Clarke gave a summary of the recent anthropological discussions at Brighton.

M. de Quatrefages summarised the results of the present Congress, and stated as the principal ones that the elements of the prehistoric populations—even of the age of stone—are discernible in the present population, and that even in the most remote ages the migrations of races took place on a much more extensive scale, and with more frequency than was believed by any one till recently. M. Vervoort, one of the Belgian vice-presidents, next presented to the Congress, in the name of M. Geefs, the well-known sculptor, a bust of M. d'Omalius d'Halloy, who presided in person at this the last meeting of the Congress. This bust is a most striking likeness of the venerable *savant*, who was congratulated by M. de Quatrefages, speaking for the Congress, on the homage rendered to him by his colleagues. M. d'Halloy's services to ethnography have been long and valuable, and his vigour of mind and youngness of heart are astonishing in a man on the verge of ninety.

The proceedings terminated with the distribution to the members of a commemorative bronze medal on the part of the Belgian Government. This medal, having a diameter of nearly seven centimetres, bears on one side, within a laurel wreath, the inscription, "Congrès International d'Anthropologie et d'Archéologie Préhistoriques à Bruxelles. 6e Session, sous la Présidence de M. T. T. d'Omalius d'Halloy, 1872." The obverse represents the Genius of Science as a female figure, seated, and pointing with her left hand to the entrance of a cavern, bearing the inscription "Furfooz," and a mammoth's skull; while on the other side of the figure the geologist's shovel and pickaxe are displayed. The medal is by M. J. Geerts, of Brussels, and is very finely executed. M. d'Omalius then formally declared the Congress terminated, congratulating the members on the scientific progress achieved, and the harmony which had characterised the meetings.

In accordance with the invitation of the Swedish Government, the next assembly of the Congress will take place at Stockholm in 1874; the proposition to confer the presidency on that occasion on Prince Oscar of Sweden was carried by acclamation. On Saturday the members of the Committee, Belgian and foreign, dined with the King.

THE FRENCH SCIENTIFIC ASSOCIATION

AMONG the subjects expected to be discussed at the general meetings of the French Association at Bordeaux are one on Fermentation, by M. Pasteur, and another on Aërial Navigation, by M. Dupuy de Lôme. In the Mathematical Section, M. d'Abbadie is expected to read a paper entitled "Expériences pour constater les variations de la verticale." In the Physics Section, M. Cornu reads a paper on the "Velocity of Light;" M. Mercadier, one on "Musical Intervals;" M. Poter, on the "Theory of Light." In the Chemical Section, M. Berthelot is to speak on "Questions of Chemical Philosophy," and M. Wurtz on "The Densities of certain Vapours, and particularly on the Density of the Vapour of Perchloride of Phosphorus." In the Meteorological Section, M. Marié Davy is expected to read a paper on "The Organisation of Meteorological Observatories."

Other expected papers are—In Geology, M. Daubrée, "Beds of Phosphates in the South of France;" M. des Cloiseaux, "Amblygonite and Martebrasite." In Botany, M. Baillon, on "*Rheum* and on the Botanic Origin of Officinal Rhubarb;" M. Chatin, "Study of the Development of the Ovule and the Grain in the Scrophularias." In Zoology, MM. de Follin, Fischer, and Périer, contribute a paper on "Recent Submarine Explorations; M. Chatin, "Researches on the Odorous Glands of certain Mammifers;" Dr. Pouchet, on "Animal Pigments;" M. de Quatrefages, on "Some Species of Inferior Animals of the Basin of Arcachon." Anthropology, M. Broca, on "The Occipital Angles." Geography, M. Gustave Lambert, on "An Expedition to the North Pole."

The Excursions are:—1. To the embouchure of the Gironde, to inspect the encroachment on the coast. 2. To Arcachon, to visit the oyster-beds, dredge the sea for molluscs, &c. 3. To Les Eyzies, to inspect pre-historic remains and bone-caves. 4. To Roueyre, to inspect the iron of the Landes, &c. 5. To Bidassoa, on the Spanish frontier, to inspect a rich bed of iron ore. 6. To Medoc, on a visit to the celebrated vineyards of Château-Margaux and Château-Monrose. Besides these excursions, visits will be made in Bordeaux itself, to M. Gintrao's establishment for rearing silkworms in the open air; to the docks, dockyards, &c., and the artesian wells of Vigan In our last number we gave a list of the public lectures.

TEMPERATURE OF THE SEA BETWEEN GREENLAND, NORTHERN EUROPE, AND SPITZBERGEN

PROF. H. MOHN, Director of the Norwegian Meteorological Institute at Christiania, publishes in *Petermann's Mittheilungen* some important facts regarding the variations of temperature in the North Atlantic. The yearly variation of temperature of the surface stratum amounts to 9° Fah. and more; it becomes less as we go down, the decline, however, being not everywhere the same. Deep-sea strata reach their lowest and highest temperatures a little later than the surface stratum, the changes offering two very distinct aspects for summer and winter. Deep-sea observations in several of the deep fjords along the Norwegian coast, which are protected against the great depth of the Atlantic by submarine ridges lying before them, show that the water in them is derived from the Gulf Stream, and that they are filled with it from top to bottom, even if the latter lies deeper than the icy bed of the Gulf Stream outside the coast region; were this not so, the temperature of the water in the fjords would be a much lower one, and Norway would not enjoy such a happy union of land and sea climate. In summer, near the coast of Norway, and in its fjords, at a depth of from 100 to 300 fathoms, we find a uniform temperature of about 44° Fah.; farther out to sea, however, at the same depth, only about 39° Fah. The deep-sea temperatures in winter are less known, but it is almost certain that at great depths the same temperature reigns all the year round, although a continual cooling from the surface downwards necessarily takes place in winter. In the north-western part of the Greenland Sea, and below the depth of the Gulf Stream, exclusively icy water is found, which somewhat compresses the latter on that side, at any rate on the surface, where the water cooled during the winter nights remains over the warmer waters beneath. Along the coast of Norway the cold from the land acts on the surface and the upper strata of the sea, increasing

with the nearness of the land, so that here the temperature of the sea rises with its depth, and the axis of warmth of the Gulf Stream is moved away from the coast towards the open sea. Taking the form of the Gulf Stream as that of its surfaces having the same temperature—isothermal surfaces—we can compare it with the shape of one of the small boats called prams, which are broadest at the stern, deeper in the centre than behind, and possessing a somewhat rounded stem. The stern of this Gulf Stream pram is formed by a vertical section from Iceland to Scotland; the longitudinal section forms the axis of warmth, running along the coast of Norway. The side nearest the Polar Ocean (the larboard side) is much more considerable than the starboard side, which leans against the Norwegian coast. In summer the starboard side is pushed quite close to the Norwegian coast, and hangs strongly over, while the larboard side is perpendicular, or only slightly inclined outward; the keel near Spitzbergen sitting deep in the water. In winter the starboard side is thirty (geog.) miles broad, and has in the parts lying nearest to the coast sides strongly inclining inward, while the strata in the centre and those bordering on the Polar Ocean rise nearly perpendicularly, the keel in the fore part raising itself almost into the position of the stem, which ends in the same point as that formed by the isotherms of the surface at this season. Generally this aspect is only presented by the part of the sea which lies westward from Norway and partly from Spitzbergen.

The warm waters of the Novaja Semlja Sea are like a wedge placed horizontally, with its base between Spitzbergen and Norway, and its horizontal sharp edge turned towards the north and east.

THE ROYAL SOCIETY OF VICTORIA

WE are glad to notice the progress of Science in Victoria as exhibited by the address of the President, Mr. Ellery, on the occasion of the annual *conversazione* held on July 8. We reprint the following extracts from the *Argus* of the following day:—

"We have now entered upon our fifteenth session, and as you have done me the great honour to again choose me as your President, it devolves on me, in accordance with our rules, to address you on the past year's history and progress of the Society; and also to call your attention to some of the more noteworthy facts which mark the last year's history of general scientific progress. First, then, in reference to our own business, I regret to have once more to inform you that, since the last publication of the *Transactions* of the Society, the funds have not been in a sufficiently flourishing condition to enable the council to resume the printing. For many years past the only revenue of the Society has been that derived from entrance fees and subscriptions of members. From this not only the current expenses but the interest on money borrowed for carrying out the alterations and additions to our buildings has to be paid; and although our income will amply meet these demands if the annual subscriptions of members are regularly paid, there has hitherto been an insufficient sum left to print our *Transactions* without other aid. The Government have been solicited for help every year since 1867, when the last aid was granted to us by Parliament. The council hope, however, that this year their request will be acceded to. I am happy to state, moreover, that (many arrears of subscriptions having been received of late) the financial condition of the Society is just now better than it has been for years. It is intended, therefore, at all events to at once print the *Transactions*, and the council trust that they may be able henceforward to publish promptly and regularly the proceedings of our meetings, which they will be quite able to do if the Parliament resumes its small annual grant-in-aid. Our last anniversary meeting was held on August 14, 1871. Since that time the Society has held eight ordinary meetings. On September 11 a valuable paper 'On Ocean Waves and their Action on Floating Bodies, was contributed by Mr. Deverill. Mr. Macgeorge also read a paper, contributed by Mr. Horne, of Adelaide, 'On a Linear Method of Finding the Stability of Ships;' and Mr. Pain, on 'Aboriginal Art and its Decadence in Australasia, Polynesia, and Oceanica.' The meeting of October 9 was occupied with Mr. Macgeorge's account of 'Changes in η Argus,' and Mr. G. Foord's 'Aërometer for Measuring Specific Gravities.' On November 13, our next meeting, the Rev. W. Kelly and Mr. Bosisto contributed papers, the former on 'On a Method of Combining Marsh's Test for Arsenic with Reinche's, so as to secure very reliable results;' the latter 'On the Cultivation of *Mentha piperita* in Victoria.' On November 22 it will be remembered the Australian Eclipse Expedition started from Melbourne. Our next meeting was a special one held on January 22, and was devoted to matters connected with the Eclipse Expedition, and to the approaching elections of council and office-bearers, which took place on our next meeting, on March 11. In April Mr. Harrison read a paper 'On Patents and their Utilisation.' Mr. Caldwell contributed one on 'Meat-preserving,' and Mr. P. F. Foord 'On Bi-angular Co-ordinates.' On May 13, Mr. F. Poolman read a description of his 'Self-Acting Safety Regulator and Coal Economiser for Steam Engines,' and Mr. A. K. Smith exhibited and described 'An Improved Valve for the Fire Plugs in Water Pipes,' the object being to prevent the entry of sewage water into the pipes when the pressure was off—a thing that might occur with the ordinary fire-plug valves. At our last meeting, on June 10, Mr. Macgeorge contributed the 'Results of Observations on Sirius and its Companions' with the great Melbourne telescope. Mr. White exhibited some new five-figure card logarithms which he had arranged, and Mr. Gibbons read a few 'Notes on M. Berthelot's Analysis of the Cranbourne Meteorite.'"

After alluding to the reports received from the Austra-Expedition for observing the total eclipse of Dec. 12, with which our readers are already acquainted, the President continued:—

"I have but little of more than ordinary interest to record of the past year's history of our several science or art institutions. The Technological Museum attached to the Public Library has made considerable progress; not only have the Commissioners established classes of chemistry, mineralogy, and practical mining, but have organised evening courses of lectures on popularised science and art. These have always been so well attended that it is to be regretted that a larger lecture-room than the one which was built for class teaching has not been erected. The earlier courses of these lectures have been printed and circulated by the Commissioners. They appear to have attracted considerable attention in England and on the Continent, especially those by Baron von Mueller on Forest Culture, and the purely technological series of Mr. George Foord. Prof. Negri, president of the Royal Geographical Society of Italy, in referring to Baron von Mueller's lecture, said he wished the Italian Government would have it translated into Italian and circulated throughout the country. A telegraph class for ladies has also been established in connection with the museum, at which pupils are instructed in the manipulation and ordinary use of the Morse telegraph instruments. It is intended, I believe, to hold periodic examinations of the pupils, and to grant certificates to such as prove themselves to be competent. The most recent step in the right direction the Commissioners have taken is the appointment of a gentleman of undoubted ability to conduct classes in geometry and mathematics. The additions that have been made from time to time to our national gallery of pictures now form a most valuable and beautiful collection, and it seems well adapted to fulfil one of its

principal objects—the foundation of a school of painting. Already we have seen in Melbourne copies after pictures in our national collection of no small merit, and giving good promises of future excellence. For so young a colony as ours the number of students is even now large, and is, I hear, increasing. The National Museum at the University, under the care of Prof. M'Coy, is becoming more complete and perfect every year; the space that has become available, through the removal of many of the mining and machinery models to the Technological Museum will be most advantageously bestowed upon numerous beautiful specimens and collections which hitherto have appeared somewhat too crowded. Botanical science in the colony, represented by our fellow member, Baron von Mueller, has made considerable progress during the past year. I have already referred to his lectures on forest culture, in which he clearly set forth the more important and lasting objects of a botanical department in a new country, and, to quote his own words, 'A botanic garden has not merely to gratify the passing hour, but has to fulfil great objects of the whole community, as well for this as for the coming generation.' Baron von Mueller, I am glad to say, intends shortly to issue some popular works on Australian botany; the first, I believe, is to be devoted to the ferns, and it is intended to illustrate it by photo-lithography. I have been also informed that Count Castelneau, the well-known zoologist, has prepared a descriptive essay on the fishes of Victoria, which is to be issued with the report of the Acclimatisation Society. I refer to these points, although they do not belong to our past year's history, because they indicate scientific vitality and progress; and although the fruition may belong to another year of this Society, the work evidently belongs to this. In our Observatory one of the most interesting results of the past year's work is the establishment of the fact that the nebula in η Argus has not only undergone marked change since the time it was observed and drawn by the late Sir John Herschel at the Cape of Good Hope, but has also exhibited notable change since the erection of the great telescope in Melbourne. Drawings of it made at intervals of only a few months, as was pointed out by Mr. Macgeorge in the paper he read before you at our October meeting, present such differences that we can now hardly escape from the impression that observable changes in this nebula take place very rapidly. Several observers in the southern hemisphere have devoted a good deal of attention and observation to this celestial object—notably, Mr. F. Abbott, of Hobart Town; Mr. H. C. Russell, director of the Sydney Observatory; Mr. Tebbutt, of Windsor, New South Wales; and Lieut. Herschel, in India. Mr. Abbott, I believe, was the first to draw attention to the fact that it no longer appeared as drawn by Sir John Herschel. Mr. Russell made a very careful drawing of the nebula as seen with the Sydney 7¼-in. refractor. Mr. Abbott also made some drawings from observations from a 4½-in. refractor, and Lieut. Herschel by the aid of a 12-in. reflector. They have all indicated that the general appearance of the nebulæ differed considerably from that represented by Sir John Herschel's drawings, although none of the apertures used could in any way pretend to reach the more minute details grasped by Herschel's 2-ft. reflector. Several of the drawings which reached home had evidently not been executed with that precision which is so necessary to establish a fact of this kind in the minds of astronomers who are unable to see for themselves. There has arisen, therefore, in the minds of many of our most renowned observers in England and elsewhere, doubts as to the real existence of these changes. For it must be remembered that the immense distance of the nebulæ from us—probably far beyond the most distant stars—makes it necessary that changes such as these described, to be visible to us even with the aid of such light-gathering apertures and optical power as is possessed by our large telescope, must be stupendous in the highest degree, and almost beyond comparison with the most ordinary cosmical changes with which we are familiar. Now, since the great telescope has been erected, special attention has been given to this object. Mr. Le Sueur devoted a great deal of time, extending over long periods, to examination and drawings, repeating his observations again after the lapse of many months. He constantly referred to me to establish or throw doubt on his observations, so that I often observed with an unbiassed eye for this purpose. The stars down to the 16th magnitude were carefully plotted (those to the 12th magnitude with the micrometer), to form an unchanging groundwork for the mapping. He announced on several occasions in this society and elsewhere that there were unmistakable changes since Sir John Herschel's drawings. Mr. Macgeorge, who succeeded Mr. Le Sueur, and who has also observed and drawn the nebulæ constantly, pointed out to you in his paper in October last the progressive changes that had been noted. The diagram he then exhibited I had photographed and sent home to Dr. Robinson (one of the Great Telescope Committee), with a copy of Mr. Macgeorge's paper. The paper got home first, and Dr. Robinson says, in a letter I received last mail: 'I lose no time in forwarding the paper to Sir E. Sabine, Mr. Lassell, and Mr. Warren De La Rue. . . . . Mr. Lassell seems to cling to the idea which he published some time ago, that there was no change whatever in η Argus. He justifies this suspense of opinion by not being able to refer to the drawings, a difficulty which I hope you will soon be able to remove. I think his real difficulty is an opinion that nebulæ must be at a distance much greater than that even of small stars, and hence an incapability of conceiving the possibility of such changes as could be visible to us.' The photographs reached him by next mail, and he then writes:—'The photographs are very remarkable, and I think it is impossible to look at them and doubt the reality of the immense changes that have taken place. Are these changes periodical? I send one of the photographs by this post to Sir Edward Sabine, with request to forward it to Messrs. Lassell and De La Rue.' It is to be regretted that the minute and careful drawings made by Messrs. Le Sueur and Macgeorge have not yet been engraved, as they establish the facts beyond all doubt, as the photographs sent home were from a somewhat rough diagram intended only to show the principal features of the observed changes. No one accustomed to observing could fail to be convinced of change going on, if he only saw the nebulæ with a power of six or seven hundred on the great telescope on good nights at at intervals of three or four months. Mr. Macgeorge reports from observations made only two months since that still further changes were evident. The full significance of these changes can hardly yet be estimated; but they overthrow many of our hitherto-received notions of the condition of these tenants of space. It is a subject of the highest interest in physical astronomy, and one that will demand unremitting observation and drawing for its further elucidation. I am glad to inform you that the Government has given me authority to publish every month the results of our observations in meteorology, terrestrial magnetism, and of other phenomena; the numbers from the commencement of the year till the end of May are already before the public. By this means all the useful information derivable from the Observatory work in these branches of investigation is made quickly and generally available. Photography of celestial objects has been commenced with the great telescope, and some exceedingly fine and promising negatives of the moon were taken, enlargements from which have already been exhibited at one of our meetings. Since April the weather has been too unfavourable to proceed with this work. Attempts to obtain photographs of planets and nebulæ

have since been made; but while those of the planets promise well, no impression whatever of the brightest nebulæ could be secured. Among the many subjects which have occupied a large share of the attention of scientific circles in the older world, and which mark indelibly the progress of scientific research during the past year, there is one which appears to me of surpassing importance. The Royal Astronomical Society awarded its gold medal this year to Prof. Schiaparelli, director of the Observatory at Milan, principally on account of his researches on the relations that exist between comets and shooting stars. You will remember in a former address I had the honour of delivering to you, I spoke of the 'meteor shower' which fell in Europe in November 186—, and that it had been established beyond a doubt that these bodies travelled in orbits intersecting that of the earth at different points; that one coterie intersected it in November, another in August, and so forth. Since then, however, it has been found from observation that the number of these meteor rings is very large, and that they intersect the earth's orbit at numerous points. And it may be stated generally, that all falling or shooting stars, at the time we see them, are, or have been very recently, members of groups travelling in true orbits, and not merely stray wanderers in space. Prof. Schiaparelli has concluded from his researches that 'celestial matter may be divided into the following classes:—1. Fixed stars. 2. Agglomeration of small stars (resolvable nebulæ). 3. Similar bodies, invisible except when approaching the sun (comets). 4. Small particles, composing a cosmical cloud.' He thinks the last occupy a large portion of space, and have motions similar to fixed stars. The latter are the sources of falling stars. Brought by the motion of our system in space within the sphere of our sun's attraction, they become in a measure part of his family and subject to him. If, while making their sun journey, they approach a planet—the earth for instance—they get disturbed in their orbits, and, becoming subject to the earth's mass, liable to enter the upper regions of our atmosphere, under which condition they appear to us as 'shooting stars.' 'Thus meteors and other celestial phenomena of like nature, which a century ago were regarded as atmospheric phenomena—which La Place and Olbers ventured to think came from the moon, and which were afterwards raised to the dignity of being members of the planetary system—are now proved to belong to the stellar regions, and to be in truth falling stars. They have the same relation to comets as the asteroids have to the planets; in both cases their small size is made up by their greater number. Lastly, we may presume that it is certain that falling stars, meteors, and aerolites differ in size only and not in composition; therefore we may presume that they are an example of what the universe is composed of. As in them we find no elements foreign to those of the earth, we may infer the similarity of composition of all the universe—a fact already suggested by the revelations of the spectroscope.' Professor Schiaparelli had noticed a remarkable likeness between the elements of the orbits of some of these meteor groups to those of some well-known comets, the perihelion passage occurring approximately at near dates, the direction of their motion alike, the point they intersect the ecliptic, and their inclination to it very similar, while the distances of their nearest approach to the sun, and their period of revolution, have also a marked likeness. The relations are very remarkable, and Prof. Schiaparelli concludes one of his last memoirs on this subject in these words:—'These approximations need no comment. Must we regard these falling stars as swarms of small comets, or rather as the product of the dissolution of so many great comets? I dare make no reply to such a question.' The conclusions of Prof. Schiaparelli are of the highest interest, and suggest some new and interesting questions on the constitution of the universe. Are the irresolvable nebulæ systems of these cosmical particles? If so it will add a fresh interest to our observations of the changes going on in that of η Argus.

"In a new country, such as ours, in which all are so fully engaged in business pursuits, it would be unreasonable to expect so large an annual crop of scientific facts as are realised in the older countries; but as the fields for original observations in a new country are really wider in many respects than in the older, it is of course, of the first importance that what we do obtain should be properly recorded and disseminated. I have mentioned that the Society's *Transactions*, the printing of which has been too long suspended, will be immediately resumed, and I believe I may confidently state that the present prospects of the Society are such as to warrant the belief that they will henceforth appear with regularity. It should be remembered that although this Society has how existed for so many years, its ranks are still thin, wanting both workers and supporters. It has been recently proposed in your council, as a means of strengthening and increasing the utility of the Society, that a rule should be adopted to admit of residents at a distance joining us as country life-members, on the same scale as ordinary members are now admitted, by payment of half the usual subscription. This will entitle such members to the Society's publications, and to all the privileges of membership when in Melbourne. I have chosen the earliest occasion for announcing this proposition, which will no doubt be presently adopted by the generality of the members. I also wish to remove an impression which, I believe, holds some ground, that advanced scientific attainments are indispensable qualifications for membership. The object for which our Society is founded was the promotion of literature, science, and art in the colony. Whoever can assist in this is, so far, eligible for membership."

NOTES

MR. STANLEY has forwarded to the daily papers a letter from Zanzibar, dated July 22nd, stating that communications have been received from the interior, which render it probable that Dr. Livingstone would receive his stores and letters about August 1st. In that case he would leave Unyamyembe about August 10th, and be now near Mrera, in Central Ukonougo.

THE following letter has been sent by Lord Granville to Mr. H. M. Stanley, the special correspondent of the *New York Herald*, accompanied by a magnificent gold snuff-box richly set in brilliants:—"Foreign Office, Aug. 27, 1872.—Sir,—I have great satisfaction in conveying to you, by command of the Queen, Her Majesty's high appreciation of the prudence and zeal which you have displayed in opening a communication with Dr. Livingstone, and so relieving Her Majesty from the anxiety which, in common with her subjects, she had felt in regard to the fate of that distinguished traveller. The Queen desires me to express her thanks for the service you have thus rendered, together with Her Majesty's congratulations on your having so successfully carried out the mission which you so fearlessly undertook. Her Majesty also desires me to request your acceptance of the memorial which accompanies this letter."

ON Monday evening the "Livingstone Search and Relief Committee of the Royal Geographical Society" met to consider its final judgment upon the conduct of the expedition under Lieutenant Dawson, which left England on the 9th of last February, and arrived at Zanzibar on the 17th of March, some months after Dr. Livingstone had been found and relieved by Mr. Stanley. The Society, however, adjourned the inquiry, and have agreed to put their questions in writing, so that Lieutenant Dawson may give them a categorical answer. The blue book

containing Dr. Livingstone's despatches of 1870, has been placed before Parliament.

THE *Times of India* of Aug. 9 contains the order of the local Government on the report of the Madras Cyclone Committee. In this order Mr. Pogson, the Government Astronomer, is severely blamed for his negligence in not giving due warning of the coming storm, as it was his duty and in his power to do. "Mr. Pogson," the order says, "endeavours to explain this omission as having been caused partly by an accident which happened to his carriage at noon on May 1, but partly also by disinclination to suggest anything to the Marine Department, his advice not having of late years been sought by that department. It does not appear to have occurred to Mr. Pogson that an occasion on which a most serious loss of life was imminent was not one for the indulgence of such susceptibilities. The Governor in Council considers that Mr. Pogson has failed to justify his negligence on this occasion. It is hardly necessary that the Government should, after the disastrous consequences of Mr. Pogson's neglect, inform him that they expect from him in future the strictest observance of that portion of his instructions which require him 'to furnish notices of approaching stormy weather,' and that the most essential part of his duty is constant, and, when necessary, personal communication with the head of the Marine Department." The Marine Department and all the officials connected therewith are severely blamed; and Mr. Dalrymple, the Master-Attendant, comes in for special censure on account of his negligence, and especially "for omitting to remain at his office during the night of May 1." The Government have ordered the appliances for saving life and property to be considerably increased, and accept in their entirety the recommendations of the Committee, which they resolve to adopt and embody in a code of rules, which will be communicated for the strictest observance by all the departments concerned.

NEXT year's London International Exhibition will consist of three divisions:—1. Fine Arts; 2. Manufactures; 3. Recent Scientific Inventions and Discoveries of all kinds. We notice that of the future Exhibttions that of 1874 will embrace Artificial Illuminations by all Methods; Gas and its Manufacture. 1875.—Hydraulics and Experiments; Supply of Water. 1876.—Photographic Apparatus and Photography, and Philosophical Instruments and Processes depending upon their use. 1877.—Health; Manufactures, &c., promoting Health, with Experiments. 1880.—Chemical Substances and Products, and Experiments; Pharmaceutical Processes.

WE have received some official details concerning the Universal Exhibition to be held at Vienna from May 1 to October 31, 1873. Her Majesty has appointed a large British Commission, headed by the Prince of Wales, to look after British interests in connection with this exhibition, which is expected to be of unusual interest, on account of Vienna being in a measure half way between East and West. The exhibition is to be held in the Prater—"the Windsor Park of Vienna"—in buildings erected specially for the purpose, and in the surrounding park and gardens. At no previous International, to judge by the official programme, have so many facilities been afforded to exhibitors. Especially is every encouragement given to the bringing forward of machinery of all kinds, the cost of exhibition to the owners being reduced to a minimum. If the Exhibition does not turn out a success, the blame can hardly be attributed to the Austrians. All information will be given to those who desire it by Mr. Philip Cunliffe Owen, Secretary to the Commission, 41, Parliament Street. British exhibitors can communicate with the Austrian Commission solely through the British Commission.

A BEQUEST of 10,000 fr. has been made to the Academy of Medicine in Paris by M. Fabret, for the purpose of founding a prize in mental and nervous diseases.

THERE has recently been formed at Amiens a Society calling itself "Société Linnéenne du Nord de la France," having for its object the study of all the branches of Natural History in its wide sense, and is divided into three sections—Zoology, Botany, and Geology. The society will hold general meetings, as well as meetings of sections, and during the favourable season will make excursions for the purpose of exploring the surrounding region. It intends to publish annually a volume of memoirs, and a monthly *Bulletin des Sciences Naturelles*.

WE are glad to be able to record the addition to the Brighton Aquarium, of a specimen of Muller's Topknot (*Rhombus hirtus*.) It was netted off the Brighton coast last week. But one capture of this rare fish off the Sussex coast is recorded by Yarrell, but it is more frequently taken off the Cornish coast. The interesting event is also announced of the birth of a young cuttle-fish, which signalised its entrance into the world by an immediate discharge of the sepia fluid.

SOME little time ago we referred to the proposed aquarium for Manchester (NATURE, vol. v. p. 487). A recent report of a meeting of shareholders, shows that it is hoped the building will be completed and opened next spring, and that temporary buildings with the necessary tanks have been provided for the reception of such marine animals and plants as can only be obtained in the summer season. They will then become acclimatised, and the tanks can be afterwards removed to their permanent places in the aquarium.

THE Committee for the Recording of Earthquakes in Scotland reported at the British Association Meeting that none had occurred within the past year. However, about the very time the report was being drawn up, and a few days before it was read, Scotland was visited by quite a sharp shock, which is thus described in the Scotch papers:—On Thursday, the 8th of August, an earthquake shock was felt at ten minutes past four o'clock at the Bridge of Allan, and was also felt over a considerable extent of country. At Braco and Kinmuck panes of glass were broken; at Dunblane and Bridge of Allan a number of houses were severely shaken, and glass was broken on sideboards. At about the same time the shock was felt in Stirling, and was attended by a loud rumbling noise like thunder. It is stated that no such sharp shock has been felt since 1839. In the evening a fine display of aurora borealis was observed in South Wales for nearly two hours.

A SLIGHT shock of earthquake was felt at Chopea, in Khandeish, on the evening of Friday, July 12, at about seven o'clock. The shock lasted for about a minute, and appears to have been felt at the same time at Amalner, Dhurrangaon, Dhulia, and Julgaon. Its course was from west to east.

A SLIGHT shock of earthquake is also reported to have been felt at Tripatore, in the Salem district in India, on the morning of the 15th of July.

AN earthquake shock was felt along the Long Island coast on July 11, and also in the northern part of Missouri, but it did no damage. A good deal of fright was caused in various Long Island villages.

A VERY violent tornado passed over Philadelphia on August 6. It was accompanied by vivid lightning and loud peals of thunder, and a tremendous downpour of rain. Trees were blown down, houses and churches unroofed, and much damage done by falling bricks and tiles, &c. No loss of life is reported, but the damage to property throughout the city is immense.

MANY of our readers will be glad to hear that Mr. Robert Swinhoe, H.B.M. Consul at Ningpo, China, is recovering from the serious illness which laid him prostrate about a year ago. Letters which were received from him by the last mail announce

his gradual convalescence, and that he was already resuming the zoological investigations which have rendered his name so well known to naturalists. Mr. Swinhoe has now succeeded in obtaining living specimens of the singular hornless deer which he lately drescribed, and figured in the "Proceedings" of the Zoological Society as *Hydropotes inermis*, and will forward them to that Society's gardens by the first opportunity. He has also obtained specimens of several mammals and birds new to the Chinese fauna.

THE *Madras Athenæum* of July 19 records the death of Capt. Mitchell, the Superintendent of the Central Museum, Madras, well-known as an accomplished naturalist and a gentleman of most engaging personal character.

DR. SCHWEINFURTH, the renowned German explorer in Central Africa, is about to return with the object of continuing his explorations, chiefly in the interests of botany. His brother, a merchant at Riga, has come forward with a handsome sum of money, the interest of which will be given to aid Dr. Schweinfurth in his undertaking, and will afterwards be handed to the Polytechnic School of Riga, to found a prize to defray the travelling expenses of future explorers who may have studied there with success.

WE learn from the *Madras Times* of July 18 that the pioneering party which was sent to Cummum some five or six months ago to bore for coal have been very successful in their operations, notwithstanding the difficulties and hardships they had to contend against. Three distinct and promising seams of coal have been struck, and the quality of the coal is spoken of as being superior to that of Sasti. The party will return to renew operations at the fall of the year. The attention of Government is also being drawn to the discovery of copper in certain districts where hitherto its presence was unknown. In the Nagur Kurnool the existence of this ore has recently been discovered, and samples of it are, with a piece of copper wire manufactured in the district, transmitted to Government, who have forwarded them to scientific men for examination and report. It is also said that copper ore has been discovered near Yedlabad, in the Indoor district; but doubts are entertained as to whether the ore is indigenous to the locality where it was found, or whether it has been washed down from the hills to the west of Yedlabad. This doubt is to be cleared up as soon as opportunity offers. The Government have also been recently directing their attention to the iron ore of the Cummum district. This is no late discovery, but the Government were not before aware of the abundance and excellence of the iron to be obtained in that part of their territories. This, it will be remembered, is also a promising coal district. So here we have side by side those two mighty engines of civilisation to which the "old country" is greatly indebted. It is much to be regretted that the resources of the territories are so imperfectly known. But the vigorous and earnest measures the Minister is taking to develop them will do much to bring them to light.

WE would recommend to those interested in scientific education and the establishment of colleges of science in this country the report of the Massachusetts Institute of Technology for 1871-72. The subjects embraced in the course necessary to qualify as a graduate of the Institute are varied, and the curriculum in each department is comprehensive and thorough. For example, the course in the department of Geology and Mining Engineering extends over four years, and is so arranged as to secure to the student a liberal mental development and general culture as well as the more strictly technical education which is his chief object. The space devoted to laboratories, and the prominence given to laboratory work, in Physics, Chemistry, Assaying, Blowpipe Analysis, Metallurgy, and Ore-dressing, is a marked feature of the scheme of instruction of the Institute. The Institute seems to flourish as it deserves.

WE have received a reprint from the "Proceedings of the Liverpool Geological Society" of the address of the President, Dr. Ricketts, on valleys, deltas, bays, and estuaries. In a thoroughly praiseworthy and fair spirit he considers the opinions that have been held from time to time by different geologists on the subject of denudation, and especially the formation of valleys. His own interpretation of the facts deserve consideration, and the address as a whole is worthy of perusal.

THE *Journal de Physique* for August contains the third part of M. Cornu's paper, "Sur les Mesures Electrostatiques," and a paper on the Electric Chromoscope of MM. F. Lucas and A. Cazin.

WE take the following from the *Chemical News*:—There are no handbooks on chemistry in the Italian language; but a work has been in course of publication since 1867 somewhat similar to the first edition of the celebrated German "Handwörterbuch der reinen und angewandten Chemie," viz., "Enciclopedia Chemica," edited by F. Selmi, of Bologna, with the co-operation of Arnaudon, of Turin, for technical chemistry, and of Sestini, Paterno, and others, for pure chemistry. There are 2,000 subscribers to this work, which is highly valued in Italy. The Italian Government has appointed Dr. Canizzaro, Professor of Chemistry at Rome; and 20,000*l.* has been voted by the Italian Parliament for the establishment of a chemical laboratory in Rome. The Florentine Institute (*Istituto Superiore*) receives, in addition to its present subsidies, an annual subsidy of 25,000*l.*, and will be converted into a kind of Polytechnic University.

THE following is from the *British Medical Journal*:—M. Lindeman continues his investigation of the parasitic bodies (Gregarinidæ) found on the false tresses and chignons commonly worn by ladies. They are to be found at the extremity of the hairs, and form there little nodosities, visible, on careful examination, to the naked eye. Each of these nodosities represents a colony of about fifty psorosperms. Each psorosperm is spherical; but, by the reciprocal pressure of its neighbours, it is flattened, and becomes discoid. Under the influence of heat and moisture, it swells; its granular contents are transformed into little spheres, and then into pseudo-navicellæ—little fusiform corpuscles, with a persistent external membrane, and enclosing one or two nuclei. These pseudo-navicellæ become free, float in the air, penetrate into the interior of the human organism, reach the circulatory apparatus, and produce, according to this author, various maladies—"cardiac affections, especially valvular affections, Bright's disease, pulmonary affections." M. Lindeman calculates that, in a ball-room containing fifty ladies, forty-five millions of navicellæ are set free; and he concludes that it is necessary to abolish false hair, which often proceeds from unclean persons.

WE have two small blue-books issued by the Government Meteorological Committee. They are both translations, specially intended for the use of seamen. The one, a paper issued by the Royal Meteorological Institute of the Netherlands, is Lieutenant Cornelissen's "Notes for the Navigation of the Indian Ocean between Aden and the Straits of Sunda," which gives details concerning the winds that affect that ocean, and contains four charts, having the outward and homeward routes for the four quarters of the year clearly indicated. The other is translated from No. III. of the *Mittheilungen aus der Norddeutschen Seewarte*, being a paper on "The Winds, &c., of the North Atlantic along the tracks of steamers to New York," and contains some carefully-constructed tables, showing the distribution, force, &c., of winds and storms in the North Atlantic throughout the year.

THE BRITISH ASSOCIATION

SECTION A—MATHEMATICAL AND PHYSICAL SCIENCE

On the Duty of the British Association with respect to the Distribution of its Funds, by Lieut.-Col. A. Strange, F.R.S.

IT is probably well known to most men of science in England that the British Association succeeded, in 1870, in inducing Her Majesty's Government to appoint a Royal Commission to inquire into the whole question of scientific instruction and the advancement of science. The Commission is composed of the Duke of Devonshire (chairman), the Marquis of Lansdowne, Profs. Stokes, Sharpey, Huxley, H. Smith (of Oxford), Sir John Lubbock, Sir J. Kay Shuttleworth, Mr. Samuelson (members), and Mr. J. Norman Lockyer (secretary). This powerful body has, since its constitution, been sedulously engaged in taking evidence. That which relates to "Scientific Instruction" has been already published, and it is now engaged in the second branch of its inquiry, namely, the "Advancement of Science." It is to this latter branch that the present communication refers.

Since the movement was begun at the Norwich Meeting of the Association in 1868, great progress has been made towards the formation of definite views as to the duty of the State with respect to Science. As having been myself examined by the Commission, and as having been in communication with many of the witnesses who have appeared before it, I am able, without intending to anticipate the publication of the proceedings, to say that the following specific points have been forcibly and extensively brought under their consideration:—(1) That the objects of scientific teaching and of scientific investigation are distinct, and require for their respective attainment distinct machinery; (2) That the State is bound, in the interests of the community, to maintain institutions—such as laboratories and observatories—for scientific research, apart from teaching; (3) That all State scientific institutions and action of every kind should be subject to the direction of a single Minister of State; and (4) That such Minister of State should have the assistance of a permanent, paid, Consultative Council composed of eminent men of science.

Of these measures, unquestionably the most important are the two last—a Minister and a Council. I believe I am justified in saying that the Commission are giving their most earnest attention to those fundamental steps on which the whole fabric of a consistent administrative system for science must be based.

The question having reached this point, it appears to me that the British Association may well now consider how they may still further advance it; and I beg to tender a suggestion to that end.

Of all difficulties in the way of science reform which, in the course of my study of the question, has appeared to me the most obstructive, I should pick out the confusion of thought which prevails as to what scientific objects should properly be undertaken, as a duty, by the State, and what objects may be safely left to be worked out by private enterprise. The confusion of thought exists even amongst scientific men; and it is characteristic in a much more marked degree of the occasional references to science made by the Government and by politicians generally. It appears to me that the British Association has it in its power to clear up this most prejudicial obscurity, and to contribute powerfully to the much-needed scientific education of the Government.

I will here briefly allude to a few recent examples of the confusion of thought to which I allude.

Mr. Gladstone, on two late occasions—namely, at the anniversary dinners respectively of the Civil Engineers' Institute and of the Royal Society—expressed the opinion that the more science was left to itself the better for it. He termed the intervention of the State as "interference" with science, calculated to discourage individual exertion, and so obstruct discovery and progress. If this opinion be sound, let us see what its consistent application must lead to. It must logically mean that the Royal Observatory, the British Museum, the Ordnance and Geological Survey, and our various botanical gardens and other scientific institutions, should forthwith be abolished as "interferences." No one has yet ventured to recommend this.

Such a recommendation would no doubt at once be met, even by Mr. Gladstone, by a clear exposition of the great importance to the nation of such institutions, and of the reasons why they cannot be maintained in efficiency but by the State. At once his general and sweeping proposition would thus be shown to be liable to so many and such extensive exceptions as utterly to destroy it as the basis of the argument. He would have, therefore, to deal with each example of proposed State intervention on its merits, and, before resisting it, to show that either it was not needed by the community, or that, being within the fair scope of private action, Government aid could be dispensed with. And this, in fact, is the only way in which we can possibly test the claims of science on the State. It seems to me that to substitute the term "interfering with science" for the more correct one of "aiding science" is as fair and rational as it would be to term our Post Office an interference with freedom of correspondence, our Railways an interference with freedom of communication, or our Police an interference with the good order of community. Yet many persons, who will not give themselves the trouble to think, will accept a word falling from an eminent man like Mr. Gladstone, even when so grievously misapplied as this, and will found upon it the most mischievous conclusions. I do not doubt for a moment that Mr. Gladstone used the word in all good faith, but I am also forced to believe that he cannot have applied his powerful and logical mind to this subject with the same energy and earnestness which have given him the mastery of so many others of equal or greater difficulty. When he has given it his full consideration, as he will shortly no doubt have to do, I am confident he will withdraw from the indefensible position he lately assumed.

Another recent example of confusion of thought as to the duties of the State is afforded by the refusal of the Government to aid in tidal researches. A committee of the British Association—of which its late president, Sir William Thomson, is chairman—has been for several years engaged on this subject. The funds provided by the Association being exhausted, application was made to Government for 150*l.* in aid. Her Majesty's Lords of the Treasury replied in these words:—"That they are fully sensible of the interesting nature of such investigations, but that they feel that if they acceded to this request it would be impossible to refuse to contribute towards the numerous other objects which men of eminence may desire to treat scientifically. Their Lordships must, therefore, though with regret, decline to make a promise of assistance towards the present object out of public funds."

If we contrast this refusal of aid to tidal researches with the aid afforded to the two last expeditions to observe solar eclipses, we shall be forced to conclude that mere parsimony and indifference to science cannot have dictated it, but that our statesmen have as yet arrived at no principle whatever on which such questions should be dealt with. The importance of eclipse observations is very great, but such researches partake, in the present state of our knowledge, more or less of a speculative character, whilst tidal researches, though bearing on various high cosmical problems, contribute in the most direct and practical manner—obvious to the least scientific person—to the welfare of our commerce and navy, and to many other branches of national activity. Yet several thousands of pounds, with the use of ships, were freely accorded by Government in the one case, and 150*l.* refused in the other. Such extraordinary inconsistency can only arise from the absence of due knowledge on the part of Government as to what are duties of the State in science and what are objects fairly devolving on private exertion.

The question I would now ask is—How can the Association help to impart this indispensable knowledge to Government?

In my opinion this can be done by the adoption on the part of the Association of some more settled rule for aiding science than those which at present prevail. So far as I know, the Association is guided, in making grants, by two main considerations only—first, the total sum at their disposal; second, the number and relative importance of the objects proposed. Acting principally on these considerations the Association has, in my opinion, whilst prompted by the most sincere desire to advance science to the utmost, contributed somewhat to the confusion of thought to which I wish to draw attention. By aiding numerous objects which, under a systematic administration of science, would unquestionably devolve on the State, they have, I fear, helped to justify that undue reliance on the all-sufficiency of private enterprise which Mr. Gladstone expressed, and on which the Government, in the case of the tides and in many others, have acted.

The remedy for this evil—which is every day becoming greater—that I would now propose is that the Association, in making their grants, shall discriminate more than they have hitherto done between objects which are national and those which are not national; and that they should give the preference to the latter. I would further recommend that a list of national scientific researches requiring immediate attention should be forwarded yearly

by the Association to the Government, with such advice as to the best mode of conducting them as may seem necessary; and that previous to each annual meeting the Association should request the Government to state what had been done with respect to such researches, the result being published in their annual volume of Proceedings.

It is not by any means my object nor my wish to bring the Association into collision with the Government. Such a result is strongly to be deprecated. But I do not believe it would follow from the course I suggest, whilst I see no other mode of putting in a practical form before the administration those urgent requirements of science on which so much of the material economy of the State rests.

The Association has undoubtedly the right to distribute funds entrusted to it by private individuals as may seem best for science. And being the most powerful scientific body in the kingdom, both intellectually and numerically, the duty properly devolves on it of endeavouring to remedy evils arising from imperfect knowledge of science wherever discernible. These two considerations afford an ample justification for the course I suggest, should it seem otherwise judicious.

It may be objected that no definite test exists by which we may discriminate between the two classes of scientific objects which for brevity I will call Public and Private. I therefore propose the following:—

Public science should be characterised by three principal features—(1) Continuity; (2) Probability of Expansion; (3) Unremunerativeness to the individual cultivating it, combined with profit or advantage to the community generally; (4) Costliness. Each individual research, properly Public, may not present all these three features in equal prominence, but with the great mass of questions which come before the Association there will be no difficulty, in most cases, in arranging each under the proper category. Cases of doubtful character must be classified according to the discretion of the Association, than whom no one can be more competent for the task.

I would here, in order to illustrate my meaning, mention a few typical cases of Public Science which the Association and other private bodies and persons have attempted to deal with. The Kew Observatory was one such case. An institution of that kind satisfies exactly all the three conditions constituting it, according to my definition, Public Science. It was discontinued chiefly on the ground that the cost of its maintenance, 600*l.* per annum, absorbed an undue proportion of the income of the Association. I was one of those who assented to its discontinuance, but on other grounds besides the one I have named. I considered that the annual sum spent upon it, though a large one relatively, was quite insufficient for such a purpose, that it needed great expansion, and finally that as long as such an institution existed, even on so contracted a scale, Government would not found a really sufficient one, as I considered they ought to do. After its relinquishment by the Association, Mr. Gassiot came forward and undertook the cost of its continuance. While offering my humble meed of admiration of such rare liberality, I must still say, what I urged when the arrangement was first proposed, that, though supplying to a certain extent a temporary want, it could not do so on the requisite scale, and that its effect would be to postpone the period at which Government would be able to see that such institutions must be maintained on the most liberal and comprehensive scale at the public expense. I also instance the subjects of Sewage, of Rainfall, of the Map of the Moon, and of the Tides, as bearing all the three characteristics of Public Science—and many others could be added. As to the Sewage question, the committee which undertook it no sooner began their labours than they perceived the utter inefficiency of the funds allowed by the Association. They sought to supplement these by appeals for help to the large towns, and questions of a delicate nature respecting the personal expenses of the members of the committee led to unpleasant consequences—the whole showing clearly that the subject was far too extensive, costly, and arduous for the powers and resources of private enterprise, and that it was, in fact, a national question which could be grappled with by national agency only.

As to the Rainfall question, it is well known that for several years Mr. Symons has devoted the greatest energy and skill to it, and that he has established a considerable number of rain-gauges all over the kingdom. He has received annual grants of money from the Association, but, unless I am misinformed, he considers the system which he has created still incomplete, and I believe he has incurred very considerable sacrifices in bringing it to its present condition. Now this case strongly illustrates the evil on which I have dwelt.

When, on the death of Admiral FitzRoy, the present Meteorological Office was established, no provision whatever was made for ascertaining the general rainfall of the kingdom. This, it was found, was being done by private enterprise, and the excuse for excluding one of the most important of meteorological elements from the programme of the State Meteorological Department was eagerly seized, although a little reflection would have shown that the very existence of the private system depended on the zeal and life of a single individual; indeed, it was threatened with total collapse that winter, in consequence of Mr. Symons' health failing from overwork.

The Map of the Moon was another large subject to which many eminent astronomers—of whom the late Sir John Herschel was one—attached much importance. The funds which the Association was able to furnish for the purpose being utterly inadequate, the project was abandoned. It is still kept alive by the zeal of Mr. Birt, assisted by a few friends; but its complete realisation by such means may be considered as indefinitely postponed. I am justified in assuming that the fact that the Association did make the attempt will be used, when the subject is pressed on the Government, as a proof that it is one properly devolving on private enterprise. I have already described the position of the Tidal question, which constitutes the most conclusive demonstration of the effect on the Government of such undiscriminating application of private funds and private enterprise.

I trust I shall not be considered, in consequence of what I have said on the subject, to depreciate or undervalue private enterprise. It is one of the just boasts of Englishmen that in no nation are there to be found such wonderful examples of individual zeal for high and unremunerative objects as here. Our colonisation, libraries, museums, hospitals and charities, the missionary agencies—all supported by voluntary means—surpass those of all the world put together. In some instances—as in that of our charities—private beneficence, for want of due direction, has actually gone too far and done harm. In science, also, England is pre-eminent for the number of observatories, laboratories, and other forms of activity maintained by individuals; whilst no civilised nation is so backward in its State organisation for science. The question I wish to raise is whether our private science, exuberant as it is, suffices for the national wants in the present age; and if not, whether the indiscriminateness of private scientific enterprise in England has not tended to induce the feeling that science is already sufficiently provided for, and does not need what Mr. Gladstone calls "the interference of the State."

I would strongly urge that no State organisation of science can possibly chill the zeal of private enterprise. The love of individual exertion, the pride of persona prowess, and the liberality of private wealth, are sentiments too deeply imbedded in the genius of Englishmen to be capable of such easy eradication. Nor will the Association find, that by the classification of scientific objects which I have recommended, there will remain of those which may properly devolve on individuals a number insufficient to absorb the moderate income which it has at its disposal.

The only other effect of such classification that appears to me open to possible objection is that some of the scientific objects which would otherwise be, however imperfectly, advanced by the help of the Association, may, by being referred to the Government, suffer total neglect. I at once admit that this effect will at first very probably take place in some instances. But for my own part I should be prepared to incur the risk of that sacrifice, in order to expedite a full consideration of the great question of the duty of Government towards science. The measure I propose is avowedly not intended to meet at once pressing temporary want, but to contribute to the creation of a great permanent system. It is my wish, not to ease, by small local applications, the sufferings of the patient, but to effect a radical cure. The treatment has as yet consisted of small expedients which, though they have given occasional relief, have not touched the seat of the disorder. I do not shrink from recommending, instead, a bold, if painful, operation that shall strike at the very root of the malady.

Report of the Committee for Discussing Observations of Lunar Objects Suspected of Change, by W. R. Birt.

The Committee have pleasure in presenting their Second Report on the above subject. It will be remembered that the Report of last year was confined principally to the discussion of

the possible variations of visibility of the numerous spots and craterlets upon the floor of Plato under the same conditions of illumination. That now presented is directed chiefly to the discussion of the various streaks and bright patches which interlace the spots and craterlets. One interesting and important change has been fairly shown; the floor of Plato becomes darker with the increase of the sun's altitude, Mr. Birt has offered an explanation of the phenomenon; whatever be the true cause of this change, it is very difficult to account for it by the ordinary laws of reflection; when we consider the varying aspect of the streaks at the same time of the luni-solar day, we cannot but think that, with careful observations made with powerful instruments such as the Newall refractor and many others, we may be able to confirm or otherwise a physical explanation of these curious changes involving the existence of certain gases and vapours upon the surface of the moon. The Committee can only look upon the study of Lunar physics as in its infancy, and they trust that in future years the Association will not overlook this important branch of astronomical inquiry.

After reading this Report of the Committee, Mr. Birt read extracts from his report of the discussion of the streaks on the floor of the lunar crater Plato which had been entrusted to him, the opening portion was to the following effect:—

"In completing the task assigned to me of discussing the observations of the streaks on the floor of Plato, I have been desirous of including every, even the most minute circumstance bearing on the exhibition of phenomena that may possibly illustrate the condition of a small portion of the moon's surface from April 1869, to April 1871. Drawing my conclusions from the experience of twelve years, I feel that I may confidently say that it may be some years before another series of observations of a particular region will be undertaken with the view of so closely examining the spots and streaks characterising it, unless a staff of efficient observers be organised, with the provision of a fund sufficiently ample to defray all the necessary expenses. The work is a difficult one, the staff should consist of not less than six devoted observers who would independently and most probably, as in the present case, work with instruments of varying aperture, and carefully record all their observations. The principal qualification is a keen eye for the appreciation of delicate variations of tint and the detection of minute spots of light, with a readiness of referring them by estimation and alignment to the respective localities of the region on which they are seen. The observations should not be allowed to accumulate, but should be forwarded at once to an experienced selenographer charged with the work of arranging and discussing them. Taking into consideration the results of the discussions of the present and previous years embodied in the two reports, it appears that in order to confirm these results and to open up new investigations the requisite time cannot well be fixed at less than three years—five would most probably afford the best results.

"The results of the present work may be briefly characterised as confirming by a direct reference to the sun's altitude above the horizon of Plato the supposition that variations of tint in some measure depend on increasing and decreasing altitudes. The ascending and descending branches of the curve obtained from independent estimations of tint by the several observers, are sufficiently near those of the sun's altitude to enable me to delineate a normal curve representative of the sun's influence in darkening the floor of Plato, or else in overspreading it with something of the nature of a dark covering as his rays strike the surface at the increased angle of about forty degrees. While this darkening influence comes out most unmistakeably, there are variations in the lighter and darker portions of the floor which are quite irreconcileable with solar influence of a gradual character. The treatment of the observations under intervals of the luni-solar day fails to bring out any regularity in these variations, and it is only by treating the observations *chronologically* that the true sequence of the changes can be detected."

Mr. Birt proceeded to notice that in order to assist in showing more distinctly the changes observed on the floor of Plato and their connection with certain supposed agencies, he had introduced the *hypothesis* of a dark obscuring medium overlying the surfaces of the lower parts of the moon; he did not insist upon this hypothesis further than its utility in connecting the observations. The Report, which was rather voluminous, referred especially to the influence of the sun on the floor of Plato; an examination of the changes recorded in August 1869, formed a separate portion of the Report as well as the history of a single streak from its first detection in September 1869, to the close of the observations. A considerable portion of the Report consisted of "Notes" furnished by the several observers.

SECTION B—Chemical Science

On Filiform Native Silver, by J. H. Gladstone, F.R.S.

The object of this communication was to show that metallic silver might be obtained artificially in the same filiform condition in which it frequently occurs in a mineral, and thus to throw light on the origin of this native variety. Specimens of the metal were exhibited, from Kongsberg in Norway, associated with calc-spar, and from Chili, associated with greenstone, and in each case the silver resembled twisted threads or wires non-crystalline, but often bending at sharp angles. Under the microscope were exhibited precisely similar threads of silver produced by the decomposition of nitrate of silver by sub oxide of copper. The latter substance is partly dissolved and partly converted into the black oxide, while filaments of the white metal shoot forth and bend in every direction. Most of these are extremely fine, perhaps $\frac{1}{20000}$ of an inch in thickness, so that, as was said, a gramme of such wire would stretch from London to Brighton. Since sub-oxide of copper is no rare metal, it seems probable that filiform native silver may often, if not always, originate from it.

SECTION C.—Geology

On the Occurrence of a remarkable Group of Graptolites in the Arenig Rocks of St. David's, South Wales, by John Hopkinson, F.G.S., F.R.M.S.

In a series of black, iron-stained shales, about 1,000 feet in thickness, which form the lowest beds of the Silurian rocks in the immediate vicinity of St. David's, the author noticed the occurrence of about twenty species of graptolite, which, he considered, furnished conclusive evidence of the equivalency of these beds with the Quebec group of Canada, the Skiddaw slates of Cumberland, and the Arenig rocks of Shelve.

The Graptolites, of which there are more than twenty species, were collected in the lower beds of the series at Ramsay Island and Whitesand Bay. Of the true Graptolites, or *Rhabdophora*, the only genera of undoubted occurrence are *Didymograptus*, *Tetragraptus*, and *Phyllograptus*. *Didymograptus* is represented by five species, three of which—*D. extensus* Hall, *D. patulus*, Hall, and *D. pennatulus* Hall—are characteristic of the Quebec group and the Skiddaw slates, *D. patulus* also occurring in the Arenig rocks at Shelve; the other species are new. Of *Tetragraptus* but one species, *T. serrus* Brong., also a Quebec and Skiddaw form, has been found. *Phyllograptus* also is only represented by a single species, which is new. There is also another new species—a very peculiar branching form referred provisionally to *Loganograptus*. The absence of any specimens undoubtedly referable to *Dictyograptus* is remarkable, as this is a common Quebec genus. *Diplograptus* and *Climacograptus*, genera of very rare occurrence in the Quebec group, have not as yet been found here.

Of the allied forms, all the genera of the so-called "Dendroid" Graptolites, so characteristic of the Quebec group, are present in the St. David's beds. *Phyllograptus* is represented by two new species, and *Dendrograptus* by five species, three of which—*D. divergens* Hall, *D. flexuosus* Hall, and *D. striatus* Hall—are at present only known to occur elsewhere in the Quebec group, the other not being new. *Callograptus* is also represented by five species, three—*C. elegans* Hall, *C. diffusus* Hall, and *C. Salteri* Hall—being Quebec forms, and two being new; and, lastly, of *Dictyonema* but one species, which is new, has been found. Many obscure impressions referred to the genus *Retiolites* also occur, one species seeming to agree perfectly, as far as its state of preservation allows of comparison with Prof. Hall's figures, with his *R. ensiformis* of the Quebec group. Another appears to be distinct from any species yet figured.

The Graptolites and their allies are now thus known to be represented in the Arenig rocks of St. David's by nine genera and about twenty-two species. Of the true Graptolites three genera—namely, *Tetragraptus*, *Loganograptus*, and *Phyllograptus*, are exclusively confined to the horizon of the Quebec and Skiddaw groups. The remaining genus, *Didymograptus*, is represented in higher rocks but by one species, *D. Murchisoni*. With this exception, *Didymograptus* is exclusively an Arenig genus occurring in rocks of this age in Canada, Cumberland and Shrop-

shire. The four genera of dendroid Graptolites have a more extensive range, but until now they were only known to occur together and in any abundance in the Quebec group of Canada.

The author then stated that he could now give another locality for these genera. During a recent visit of the Geologists' Association to Ludlow and the Longmynds he had found, at Shelve, in the lower part of the Arenig rocks, underlying the great mass of the Llandeilo, a Graptolite zone in which these four genera are represented by species, some of which are identical with, and others nearly allied to, those in the St. David's beds and in the Quebec group of Canada; these beds, and also the Skiddaw slates of Cumberland, being therefore of Lower Arenig age.

Prof. Harkness, after referring to the labours of Mr. Hicks, remarked upon the occurrence at so early a period, of so many new forms of life, alluding especially to the discovery of a star-fish. He thought the name Skiddaw would be more appropriate for the beds immediately underlying the Llandeilo flags, than Arenig, although he acknowledged that the latter name was one which had been a long time in use.—Prof. James Hall, of Canada, on being called upon, said that he had examined the specimens on the table and was much pleased to find the Graptolites from St. David's so intimately allied to those he had described from the Quebec group; indeed had he not known where these specimens had been obtained he should have thought that they had really come from some of the beds in Canada. Allowing for differences caused by pressure and cleavage, the resemblance between these and the Canadian forms was truly remarkable.—Dr. Nicholson said that *Didymograptus* had a wider range than Mr. Hopkinson had given, several species of this genus being found in the Llandeilo flags in the south of Scotland and elsewhere.—Mr. Hicks, in his reply, said that he was pleased to find that Prof. Hall so thoroughly agreed with his ideas of these beds in regard to their equivalents in Canada. In reference to the remarks of Prof. Harkness as to the name of Skiddaw being preferable to that of Arenig, he said that as some of the rocks in the Shelve district which had for some time gone under the name Arenig, were now proved to be the equivalent of these beds, he thought it best to adopt this name.—Mr. Hopkinson, in reply to Dr. Nicholson's observation on the genus *Didymograptus*, stated that the species referred to by Dr. Nicholson, in his opinion belonged to a distinct genus to which he had given the name *Dicellograptus*, and which differed entirely in structure from *Didymograptus*. He was very glad to find his views of the equivalence of the St. David's beds, as shown by their Graptolites, with the Quebec group of Canada so decisively confirmed by Prof. Hall.

Saturday, August 17.—*Sur les divisions de la Craie en France, leurs limites et leur faune, l'identité de ces divisions des cotés du détroit*, by Prof. E. Hébert.

The author objected to the divisions of the chalk commonly adopted in England, into chalk with flints and chalk without flints. He proposed to subdivide the chalk according to the characteristic fossils of certain horizons, affirming that the divisions thus adopted were constant, and could be applied as well to the English chalk as to that of France. Taking the Gault as the natural base of the chalk, he classed the overlying beds, in ascending order, as follows:—1. *Craie glauconieuse* (Upper Greensand and Grey Chalk); 2. *Craie à Inoceramus labiatus* (Chalk marl, chalk without flint, and part of the chalk with flint); 3. *Craie à Micraster cor-testudinarium* (part of the chalk with flints); 4. *Craie à Micraster cor-anguinum* (chalk with flints); 5. *Craie à Belemnitella mucronata* (Norwich chalk).

Between the first and second divisions comes the great series of Sandstones of the Maine; and between the second and third division comes the Hippurite limestone. These beds are not represented on the coasts of the English Channel, but at the points where the "breaks" occur there are hardened beds of chalk, often pierced with holes.

The author showed that the chalk area of the North West of France is traversed by five well-marked anticlinal folds, which run in a general south-westerly direction, but converging somewhat towards the coast. These folds the author identified with some on the English coast.

Mr. Davidson then made some remarks upon Prof. Hébert's paper, pointing out that the Upper Greensand in parts of England assumes a much more important character than that given to it by Prof. Hébert. Prof. Phillips, Mr. Godwin-Austen, and Mr. Seeley also took part in the discussion, Prof. Phillips remarking upon the great good that results from meetings of this kind, at which geologists of different countries could meet and personally discuss their views.

Monday, August 19.—Three Reports were read at the commencement of the meeting. That by J. Thomson, *On the Continued Investigation of Mountain Limestone Corals*, dwelt upon the great difficulty which had been experienced in determining the species and genera of corals. The author showed that all systems of classification founded upon the arrangement of special parts of the coral were artificial and misleading. He had prepared careful drawings tracing the coral through the whole of its stages of growth, and he believed that only in this way could we arrive at satisfactory results.

Prof. Duncan and Prof. Jas. Hall both insisted upon the great difficulties that were encountered in classifying corals. It was clear from this discussion that in the corals at least there is no lack of the "intermediate forms" which Mr. Darwin assumes to have existed in all groups of animal and vegetable life.

Dr. Bryce, in his *Report on Earthquakes in Scotland*, said, that nothing of importance had occurred during the past year, no disturbance of the earth's crust or oscillation of the lakes had been observed. The attention of the committee had been turned to the remedying of those defects which from time to time are apt to occur with instruments long in use. It was stated that the Seismometer belonging to the Association, which now occupies the lower part of the parish church of Comrie, is of too complex construction for general use. Simpler and cheaper instruments have been constructed by Mr. Geo. Forbes, which will be distributed amongst the stations of the Scottish Meteorological Society, and the results obtained will be detailed in a future report.

Mr. W. Jolly's *Report on the Discovery of Fossils in certain remote parts of the North West Highlands*, was likewise richer in promise than performance. Certain work had been done in investigating the limestones occurring with the Laurentian Quartzites and Sandstones, but the best part of the report was the announcement that the clergy and schoolmasters of the district had entered warmly into the projects, it was therefore hoped that before the next meeting of the Association a good deal of valuable information as to fossiliferous localities would be obtained.

On the Geology of the Thunder Bay and Shabendowan Mining Districts on the North Shore of Lake Superior, by H. Alleyne Nicholson, M.D., D.Sc.

Having recently had an opportunity of accompanying an exploring party to the north of Lake Superior, the author had been able to examine geologically the silver-mining district of Thunder Bay, and the gold-bearing district of Shabendowan (sixty miles to the north-west of Thunder Bay). Having described the chief geographical features of Thunder Bay, the author gave an account of the series of rocks known as the "Lower and Upper copper-bearing series." The chief argentiferous lodes were also described, and the more important mines were shortly noticed. The leading geological features of the country between Thunder Bay and Lake Shabendowan were next glanced at, and a detailed account was given of the geology of Lake Shabendowan itself The most interesting rocks described are the so-called "talcose" slates, in which the auriferous lodes are situated. These slates are of Huronian age, and they occupy, along with interstratified and intrusive igneous rocks, a vast area, which extends to an unknown distance north of Lake Shabendowan. Having described their mineral characters, the author expressed his opinion that these "talcose slates" are truly of the nature of bedded felspathic ashes, and that the talc which they often contain is a secondary product developed in them as the result of the metamorphic action to which the whole series has evidently been subjected. It was shown also that these Huronian slates, with their interstratified traps, presented the most striking resemblance to the Borrowdale series of green slates and porphyries of Cumberland and Westmoreland. The paper concluded with a description of the chief auriferous veins which have hitherto been found traversing these rocks.

On Ortonia, a new genus of Fossil Tubicolar Annelides, with Notes on the Genus Tentaculites, by H. Alleyne Nicholson, M.D.

Having recently had the opportunity of carefully investigating the genus *Tentaculites*, the author was led to the conclusion that fossils of diverse zoological affinities had been included under this head (Amer. Jour. Science and Arts, vol. iii. 1872). The author showed that some fossils formerly referred to *Tentaculites* were truly Pteropods, whilst others were genuine tubicolar an-

nelides. For some of the latter he had proposed the genus *Conchicolites;* and he restricted *Tentaculites* to straight unattached conical tubes. With this restriction the genus may safely be regarded as Pteropodous, since no Pteropod has an irregularly bent or twisted shell, and none can possibly have a shell attached parasitically to foreign bodies. In the present communication the author founded a new genus for the reception of a fossli which had been kindly sent him by Mr. Edward Orton, of the Geological Survey of Ohio, after whom he proposed to name the genus *Ortonia*. This fossil had formerly been referred to *Tentaculites*, and is of common occurrence in the Lower Silurian (Hudson River group) of south-western Ohio. No doubt can possibly be entertained as the proper reference of this fossil to the tubicolar annelides. Only a single species is known, which the author named *O. conica*, and this occurs in the form of conical tubes attached by the whole of one surface to the shells of Brachiopods and other molluscs, *Strophonema alternata* being the form which is most commonly infested in this way. The sides of the tubes are furnished with strong annular ridges, which die away upon the dor al surface, leaving a narrow vacant space or belt of a peculiar cellular character, exhibiting numerous small alveoli, strongly reminding one of the peculiar cellular structure of the tube of *Cornulites*. From this latter *Ortonia* is separated by the complete attachment of the tube along one side, and by its much smaller size. From *Conchicolites* it is distinguished by its mode of attachment, and by never growing socially in clustered masses.

The Rev. Canon Tristram's paper *On the Geology of Moab* was then read. After referring to the researches of M. Lartet and others, the author described the general structure of the southern end of the Jordan valley, which, he said, coincided with a great synclinal depression. The lowest rocks exposed are New Red sandstone; these occur only on the east side of the Jordan, and are there capped by tertiary limestone, resembling that of the "back-bone" of Palestine. Abundance of springs break out at the junction of the limestone and the New Red, rendering the eastern shores of the Dead Sea very fertile. On the west side only three springs occur, and, excepting near these spots, the country is barren. Great deposits of marl are heaped against the western banks, but only a little of this occurs on the eastern side. Many streams of basalt occur on the eastern side of the Dead Sea. These overlie the tertiary limestone, and are, therefore, of later age than that. The origin of the lava flows is not yet known—no craters were observed in this district.

To the north-east of the Dead Sea, on the east of the New Red plain, there is a range of hills formed of tertiary limestone. Beyond, to the east of this, the Arabs tell of a vast volcanic tract, covered wlth ruined cities, which is as yet wholly unexplored.

In the course of the discussion, Prof. Hull remarked that the statements of the author gave a good example of the formation of a valley by disturbance, and he thought that comparatively little was due to denudation. Mr. Topley thought that even if a fault or synclinal ran along the valley, yet the valley itself was still due to denudation. Even if this were not the case, there was the line of hill, or an escarpment of tertiary limestone, on the north-east of the Dead Sea. The westerly continuation of this had been removed by denudation. He saw no reason why the whole of this denudation should not have been subaërial, the material having been carried southwards down the continuation of the Jordan valley before the great depression was proved. All the evidence compels us to believe that the great depression is of extremely recent geological age.

Canon Tristram, without giving an opinion as to the denuding agents, thought that the valley of the Jordan was marked out, and in great part formed by disturbance. In reply to Mr. Sharp, he said that the Moabite stone was a block of basalt of the country. Many such blocks of basalt are preserved at the houses there. In reply to Mr. Scott, he observed that the great deposits of salt at the southern end of the Dead Sea were of New Red sandstone age. The great saltness of the Dead Sea is mainly due to this salt being washed down by streams. Salt occurs all along the line wherever the New Red sandstone has been brought up, as in the Sahara and elsewhere.

On the Trachyte Porphyries of Antrim and Down in the North of Ireland, by Prof. Edward Hull, F.R.S., Director of the Geological Survey of Ireland.

Trachyte is one of the rarest of the British rocks, and it is as yet uncertain whether it is to be found amongst these islands except in the North of Ireland. In this district it was discovered and identified by the late Prof. Jukes and Mr. Du Noyer during the progress of the Geological survey in the year 1867. No description has as yet been published of this remarkable species of volcanic rock, and I propose to give a short account of its characters and relations to the surrounding formations as it occurs both in Antrim and Down.

Trachyte Porphyry of Antrim.—The principal mass forms a group of eminences about four miles to the north of the town of Antrim, called Tardree mountain, Carnearny Hill (1,043 ft.,) Brown Dod Hill and Scolboa Hill. The tops of three of these hills are formed of basalt in beds capping the trachyte rocks, and it is supposed that basaltic sheets enclose the whole of the trachytic district; though the survey of the district being incomplete the actual limits have not been determined in every direction.

The mineral constitution of the trachyte is generally uniform, although the relative proportions of the individual minerals occasionally vary. In general, the rock consists of a nearly white or grey felspathic base, with individual crystals of Sanidine, a triclinic felspar, blebs or grains of smoke quartz, and rarely a little mica. In some places the grains of silica are exceedingly abundant, giving the rock the appearance of Rhyolite or Perlyte as described by Cotta, minute crystalline grains of magnetite appear in a sliced section under the microscope. It is in this state that the iron mentioned in the analysis below probably occurs.

The rock is quarried as a building stone at Tardree mountain, where it sometimes assumes a columnar structure. A specimen from one of the quarries was subjected to an elaborate analysis by Mr. E. T. Hardman, of the Geological Survey of Ireland, who gives the following as the constituents:—*

Analysis of Trachyte Porphyry, Tardree quarry.

Silica	76·960 per cent.
Alumina	5·101 ,,
Peroxide of Iron	2·344 ,,
Lime	7·064 ,,
Magnesia	0·294 ,,
Potash	4·262 ,,
Soda	1·818 ,,
Loss by ignition	2·102 ,,
Phosphoric acid	trace
	99·943
Specific gravity	2·433

Relations of the trachytic and basaltic rocks. — During a recent visit I was enabled to ascertain with the greatest certainty the relative position of the trachytic to the basaltic rocks of the district. In the first place, there does not appear to be any passage or graduation of the two classes of volcanic rock into each other, and each having been erupted and spread out in sheets, exhibits a laminated, or bedded structure, which enables the observer to determine their relative positions without much difficulty. Both at Carnearny and Tardree Hills the trachytic porphyry may be observed to dip beneath the basaltic rocks of the surrounding country; and the observations made here and elsewhere tended to show that, of the two kinds of rock, the trachyte is the older.

On the other hand, both at Carnearny Hill and Scolboa the trachyte seems to have been penetrated by "necks" of later date filled with basalt, from which some portions of the overlying basaltic sheets may have been erupted. We are not, however, as yet in a position to say whether or not the trachyte is the oldest and lowest of all the Tertiary Volcanic rocks of County Antrim, as its base is nowhere exposed.†

The events which have taken place in the volcanic history of this locality appear to have been as follows:—

At some early stage of the miocene period large masses of trachytic rocks were poured forth from one or more vents, doubtless accompanied by craters as in Auvergne. After, probably, a long interval of repose new interruptions of basalt and dolerite took place through fissures and small volcanic vents breaking in some places through the trachyte. These later eruptions of basalt may have enveloped the whole of the trachytic masses which have been subsequently laid bare by denudation. The denudation of this region has been very great during postpliocene and later times; and to it is due the obliteration of the

* Jour. Roy. Geological Soc. Ireland. Vol. iii. part i. p. 27. (New Ser.)
† Messrs. Hull and J. L. Warren. Explanatory memoir to sheet 36 of the Geological Survey of Ireland (1871).

actual craters of eruption over the whole volcanic region of Antrim.

Trachyte Porphyry of Co. Down. This rock is very similar in appearance and constitution to that of Antrim, consisting of a greyish felsitic base with crystals of sanidine and blebs of quartz. It is only visible at Ballyknock, about four miles west of Hillsborough, surrounded on all sides by Lower Silurian rocks, but not very far distant from the margin of the basaltic plateau of Antrim. There can be little doubt that it is of the same age as the trachyte porphyry of Antrim; both being referable in all probability to the great volcanic outbursts of the miocene period.

Considerable uncertainty exists regarding the relations of the Downshire trachyte to the volcanic rocks of the adjoining country. It only appears in two or three spots within a small area: but the probabilities are, that it is portion of an old neck from which trachytic lava was erupted contemporaneously with that of Antrim, the higher portion of the mass as well as the original vent having been removed by denudation. The district has since been deeply buried beneath boulder clay.* The author then proceeded to show the similarity of the Antrim volcanic rocks with those of Auvergne, the Siebengebirge and Eifel districts.

SECTION D—Biology

SUB-SECTION ZOOLOGY AND BOTANY

On the Occurrence of the Supra-Condyloid Process in Man, by Prof. Struthers, of Aberdeen.

The author showed dissections of this part in several animals. An arch of bone is thrown, like a bridge, over the great nerve, and generally also the great artery of the limb, a little above the elbow, protecting them from pressure and injury. No such structure exists normally in the human arm, but it occurs occasionally as a variation. When it exists, the process grows from exactly the same spot as in animals which possess it, and the arch is completed by a ligament, the nerve and generally also the artery passing through the arch. This variety had attracted some notice lately, and is supposed to be very rare, but the author has found it often, and he exhibited a large number of specimens of it from the human arm, in its various degrees of development. He had also met with it occasionally in the living body, and had lately been able to prove the correctness of his previous supposition that it may be hereditary, having met with it in the members of a family, in the father and in two sons. The author remarked on the great interest attaching to this variation. In animals which possess it, it is what, in olden phraseology, would be called a contrivance specially designed for the protection of the nerve in them, and it looks as much a piece of contrivance as London Bridge or Temple Bar. But why should the same contrivance occur as a variety in man? The old argument from final cause, and no less its successor the theory of "type," besides being metaphysical, becomes untenable in the face of the existence of these rudimentary structures. The theory of so-called type has a great deal to answer for in obscuring the natural interpretation. If species are of independent origin, how comes it that animals have in their bodies parts of other animals, parts which are of no use to them, sometimes even dangerous to them? To those who are able to overcome the prejudices of their early education, the evidence comes with irresistible force in support of the hypothesis of the origin of species by evolution.

On the Sternum and Pelvic Bone in the Right-Whale and in Great Fin-Whales, by Prof. Struthers.

The sternum exhibited showed a very different form from that of the same species of Fin-Whale which Prof. Struthers had brought under the notice of the Association last year. Instead of a singled median cervical process, it has a deep median notch with a broad crest on each side; and the posterior process is very narrow. Two sterna of the Greenland Right-Whale exhibited were large. The author divides the sternum into three parts. The middle between the first ribs is thick, completing the thoracic girdle, and essential. The part in front of this, and the part behind it vary greatly, being more or less rudimentary. The sternum of the Finner has two joints with the first rib, that of the Right-Whale only one joint, and this difference in the thoracic adaptation, together with the great breadth of the first rib in the Right-Whale, might explain the very different forms presented by this bone in these two kinds of whales.

One of these breast-bones exhibited marks of former inflammation of the bones. The author mentioned that he had often met with this condition in whales, in some cases ankylosis of vertebræ had resulted, and in some there must have been considerable suffering to the animal. This fact might be commended to the notice of those, if there be yet any such, who have the notion that disease occurs in animals only when they come under the influence of man.

On the Occurrence of Finger Muscles in the Bottle-Nose Whale (Hyperoodon bidens), by Prof. Struthers.

This bottle-nose stranded on the Aberdeenshire coast just after the meeting of the Association last year at Edinburgh, at which the author read an account of the finger-muscles in the great Fin-whale, first noticed by Prof. Flower. It had been believed that these muscles do not exist in the toothed whales, but in this bottle-nose they were even better developed than in the Finner. The extensor muscles especially were better marked, the external extensor, corresponding to the so-called extensor of the little finger of man, being also present. An extensor *carpus radialis* was also present. Besides the muscles which were known to exist at the shoulder and arm in the Cetacea, he found a representative of the biceps present here. These muscles were mainly to be regarded as rudimentary, but they had a certain low amount of function by which their presence as muscles is maintained. In some other cetaceans they are represented entirely by fibrous tissue. Prof. Struthers exhibited also a dissection of the rudimentary teeth concealed in the gum of this bottle-nose. They are alive but useless, and their presence could be reasonably interpreted only by the hypothesis of evolution.

SUB-SECTION ANTHROPOLOGY

Exploration of some Tumuli on Dartmoor, by C. Spence Bate, F.R.S.

The author had examined several cairns of the usual kind common on Dartmoor with but little success; they apparently had been previously rummaged by unknown hands. In one, a broken urn and an implement of white slate was found; the latter was supposed to have been that with which the potter formed the rude urn.

On Hamel Down, near the centre of Dartmoor, the author explored a barrow composed of earth surrounded with small stones; in this he found, beneath five large stones which were placed horizontally one beside the other, some burnt bones on the ground, a bronze dagger blade, and an amber ornament inlaid with gold, which is supposed to have been the extremity of the handle of the dagger.

The author contends that from the character of this interment, the burnt bones not being enclosed within an urn, and the amber ornament taken together with the names associated with the locality, are evidence of an early incursion of the old Scandinavian Vikinger in search of that tin which was necessary for them to manufacture their bronze.

On the Ethnological and Philological Relations of the Caucasus, by Hyde Clarke.

This paper communicates the further researches of Mr. Hyde Clarke on the classification of the languages of the Caucasus. It identifies (1) the Ude with the ancient Egyptian and Coptic; (2) the Abkhass with the Agau, Falasha, &c., of the Upper Nile; (3) the Circassian with the Dravidian; (4) the Georgian, Lazian and Sivan with the Caucass—Tibetan. The Ude and Abkhass are connected with the statements of Herodotus (Book II.) as to the Egyptian colony established in Colchus by Sesostris. Mr. Hyde Clarke observed that the Caucasus was not a centre of population for the world, but a place of passage, and showed the relations of the Abkhass (Agau) and Circassian with the Ougeners in Europe, Africa, Asia, Australasia, and America, illustrating the common population of the new and old world, and the knowledge of America by ancient nations, dimly preserved, though not understood by the Greek and Roman geographers.

The Origin of Serpent-worship, by C. Staniland Wake.

After referring to various facts showing the existence of serpent-worship in many different parts of the world, the author proceeded to consider the several ideas associated with the serpent among ancient and modern peoples. One of its chief characteristics was its power over the wind and rain; and a

* Mr. Hardman considers that the amount of lime shown by the analysis, proves that the trachyte has undergone some amount of metamorphosis or alteration, and considers it probable that it is consequently older than the basalt of Antrim, a view which subsequent examination in the field has enabled me to verify.

second, its connection with health and good fortune, in which character it was the agathodæmon. It was also the symbol of life or immortality, as well as of wisdom. This reptile was viewed by many uncultured peoples as the re-embodiment of a deceased ancestor, and descent was actually traced by the Mexicans and various other peoples from a serpent. The superstition thus became a phase of ancestor worship, the superior wisdom and power ascribed to denizens of the invisible world being assigned also to their animal representatives. When the simple idea of a spirit ancestor was transformed into that of the Great Spirit, the father of the race, the attributes of the serpent would be enlarged, and it would be thought to have power over the rain and hurricane. Being thus transferred to the atmosphere, the serpent would come to be associated with nature or solar worship. Hence, the sun was not only a serpent-god, but also the divine ancestor or benefactor of mankind. Seth, the traditional divine ancestor of the Semites, was the serpent sun-god, the agathodæmon, and various facts were cited to establish that the legendary ancestor of the peoples classed together as Adamites was thought to possess the same character. It appeared that serpent-worship, as a developed religious system, originated in Central Asia, the home of the great Scythic stock from which the civilised races of the historical period sprung, and that the descendants of the legendary founder of that stock, the Adamites, were in a special sense serpent-worshippers.

Sir Walter Elliot read a paper *On Some of the earliest Weapons in Use among the older Inhabitants of India*. These he traced to a curved "throw-stick" resembling, but differing from, the Australian bomerang, in as much as it does not return to the hand when thrown. The Indian "throw-stick" is found among the rude races inhabiting the mountain and forest tracks of Central and Western India, as the Dhangars, Kolis, and Gonds, and more to the South, the Kallars, Marawars, and other low castes. In waste and jungle tracts the people turn out in great numbers during the hot season, commencing with the first day of Hindu new year in March, and continued on every succeeding Sunday till the Monsoon begins. Hares, deer, hog, pea-fowls, partridges, &c., raised by this lowly race of beaters, each carrying a "throw-stick," are knocked over by showers of these weapons, thrown with great force and precision.

From the form of such sticks, which are from 1½ to 2 feet long and 3 to 6 inches broad, thrown with the concave side foremost, the author deduced the form assumed by the iron weapons subsequently formed by the same races. Specimens of these were exhibited, such as the Gurkha knives of Nipal, those of the Nairs, Moplas, and of the Malabar coast, and the common woodman's knife used everywhere, and which the late Capt. Forsyth states the Gonds, Bygas, and other tribes of the central Highlands throw at game with wonderful precision. These remarks apply more particularly to the Druoidian races, although not exclusively so. The earliest or aboriginal people now represented by the servile classes, seem to have used stone implements like people of the same condition in Europe and elsewhere, while the early Aryans passed through a bronze or copper period—specimens of the weapons of which era were exhibited.

Sir Walter observed that Prof. Huxley in classifying the varieties of the human race, exclusively for physical characters, had included under one head the people of New South Wales, of the Highlands of Central India, and of Ancient Egypt, all of whom he includes under the term Australoid. Now it is a remarkable coincidence that among these three far distant peoples the "throw-stick" was the weapon of the chase, and that examples do not occur in the intermediate countries. The pictures in the tombs of the kings at Thebes represent hunting scenes in which the curved sticks found at this day in India are extensively represented. The bomerang of Australia is precisely of the same form, but, being thinner and lighter, is so fitted to have a recoiling property.

SECTION E.—GEOGRAPHY

On the Orography of the Chain of the Great Atlas, by John Ball, F.R.S.

The representations of the chain of the Great Atlas given on the most modern maps show how very vague and incomplete our knowledge still is. They agree in very little beyond the fact that high mountains extend in a nearly direct line from the west coast, where they approach the Atlantic, near Agadir, in about 30° 30′ N. lat. for about 500 miles inland, where they subside at no great distance from the frontier of Algeria about the parallel of 33° 30′.

All but the most recent maps indicate a single range similar in general character to that of the Pyrenees, while in these we find represented two nearly parallel ranges at an average distance of sixty or seventy miles, of which the northernmost alone terminates near the Algerian frontier, its axis lying exactly in the line of the great shallow lakes, or chotts, that occupy a great part of the high plateau of southern Algeria, while the southern range, with some slight interruption, is continuous with the elevated zone that forms the northern limit of the Algerian Sahara. The details, however, as given in these recent maps, are strangely discordant, especially in regard to the region lying E. and N.E. from the city of Morocco, and connecting the main range with the mountains of North Morocco.

It is not surprising that such discrepancies should exist, when it is known that the best maps have been compiled with no better materials than the reports of natives, and that none but a very small portion of the entire region has ever been traversed by civilised men. In regard to Gerhard Rohlfs, one of the most remarkable of recent African travellers, it must be remembered that he was forced to maintain a rigid disguise, to associate constantly with natives, and to suit his movements to theirs. He was unable to make more than scanty and occasional notes, and was altogether debarred from the use of instruments. It is not surprising that, under such conditions, his contributions to the topography of a region never before visited by European traveller tend more to excite than to satisfy curiosity.

During the spring of last year the Sultan of Morocco, at the request of the British Minister, Sir John Drummond Hay, granted permission to Dr. Hooker, the eminent Director of the Royal Gardens at Kew, to explore the portion of the Great Atlas subject to the Imperial authority; and although the main object of the party, consisting of Dr. Hooker, Mr. Maw, and myself, was to investigate the Flora of the mountains, it might not unreasonably be expected that we should be able to make some considerable addition to existing geographical knowledge in regard to a region so little known.

Those who are best acquainted with Morocco will be least surprised to learn that in this respect the expedition has not borne abundant fruit. The obstacles which stood in the way were partly anticipated by us, but were in great measure insuperable.

The authority of the Sultan extends over but a small portion of the region included under the denomination Great Atlas. It is in fact limited to the northern declivity of the main chain, and only throughout the western part of this, for it extends to a distance at the utmost not more than 120 miles E. of the city of Morocco. The time at our disposal was too limited to enable us to explore even the limited field that was thrown open to use The cares and responsibilities attaching to his official duties prevented Dr. Hooker from prolonging his stay in and near the mountains beyond about three weeks, and the private engagements of Mr. Maw compelled him to separate from us and to return to England at a still earlier date. But by far the most serious obstacle which we encountered arose from the persistent though covert opposition of all the persons holding local authority, aggravated and not seldom stimulated by the chief of our escort, whose charge, as we had been assured, was to remove all impediments from our path.

But for the difficulties incessantly placed in our way, we should undoubtedly have attained several of the higher peaks, and could not fail to have learnt a good deal respecting the disposition of the greater masses and the direction of the main valleys in the territory which we could not actually traverse.

In point of fact we were able to make but two considerable ascents. On the first occasion, when we ascended the Tagherot Pass in a storm of snow and hail that completely intercepted all distant view, the cold was so severe that we willingly turned our faces from the storm when only Mr. Maw, the foremost of the party, had actually set his foot upon the summit, about 12,000 feet above the sea level. On the second occasion, after Mr. Maw had departed from us, we attained a conspicuous peak, called Djebel Tezah, about 11,500 feet in height, in a much lower part of the range than that previously visited. In addition to the very limited results of personal observation, we naturally availed ourselves of every promising opportunity for obtaining topographical information from natives. Much of the information obtained in this way appears to me utterly unreliable, especially when derived from persons holding local authority, but the particulars supplied

by a very intelligent Jew residing in Morocco, so far as they rest on personal knowledge, deserve more confidence.

The following are the chief points as to which I think myself entitled to express an opinion, premising that as to some of them I may place undue confidence in my own personal conclusions :—

1. The portion of the Atlas chain that is seen from the city of Morocco is considerably higher than has generally been supposed. The higher summits approach nearly to the same elevation, and the majority of these approach very nearly, if they do not occasionally surpass, the level of 14,000 feet. Westward of the district of Glaoni, S.W. of the city of Morocco, the range subsides gradually as it approaches the coast.

2. There is a certain amount of tolerably good evidence tending to show that the interior part of the range extending from the upper valley of the Wed Tessaout to Eastern Morocco contains peaks of higher elevation than any seen by us.

3. The existence of an anti-Atlas or range parallel to the main chain, and enclosing on the south side the great valley of the Sous, was established by Rohlfs, if not by previous travellers; but we are probably the first who have looked across the wide intervening space and scanned the outline of the anti-Atlas. The portion seen by us at a distance of from 50 to 60 miles is far less bold in form than the main range. The utmost height of that portion can scarcely exceed 10,000 feet.

4. The map, compiled by Capt. Beaudouin, and published in Paris at the Depôt Général de la Guerre in 1848, which is decidedly the best that has hitherto appeared, is defective in representing the main chain as arising abruptly from the low country, scarcely indicating considerable lateral valleys. At the same time it should be remarked that the projecting ridges which divide these lateral valleys appear to be lower in comparison with the peaks of the main chain than is usual in other great mountain ranges.

5. There is a marked tendency to the formation of considerable valleys parallel to the main chain, and in such cases the remark made in the last paragraph does not apply. Some of the higher peaks, and amongst them those named Miltsin by the late Captain Washington, lie in ridges nearly parallel to the main chain.

6. It appears at least possible that the Anti-Atlas, if we may so denominate the range forming the southern boundary of the Sous Valley, is merely an example on a large scale of one of the parallel ridges just referred to, many examples of which are to be found in better known mountain regions.

7. The existence of two parallel chains so continuous as those represented in Gerhard Rohlfs' map appears to be open to reasonable doubt. In the absence of direct evidence, it appears at least equally probable that the conformation of the main chain may be best represented by a series of ridges slightly inclined to the axis of elevation of the entire mass.

8. The remarkable valley of the Beni mquald, laid down on Beaudouin's map as extending more than one hundred miles from S.E. to N.W. in a nearly direct line must be pronounced imaginary or based on false information. The details given in Rohlfs' "Reise durch Marokko," however incomplete, are manifestly inconsistent with the general plan of the mountain system laid down in that map.

SECTION G—Mechanical Science

Experiments on Surface Friction in Water, by W. Froude, F.R.S.

The object of investigation was to determine the laws which govern this force, in those especial relations under which it forms a portion of the resistance experienced by a ship when moving through the water at various speeds.

These are, (1) the relation of the force to the speed, (2) its relation to the quality of the surface, (3) its relation to the length of the surface along the line of motion. The necessity of investigating it under the latter of these relations, may not be at once obvious, it having been generally held that surface friction varies directly as the area surface, and will be the same for a given area whether it be long and narrow or short and broad. But a little reflection shows that this cannot be so, because the portion of surface that goes first in the line of motion, in experiencing resistance from the water, must reciprocally communicate to the water motion in the line in which itself is moving, and, consequently, the portion of surface which succeeds the first, must be rubbing, not against stationary water, but against water partially moving with it, and cannot experience as much resistance from it.

The experiments were performed with carefully-made apparatus, which automatically recorded the resistance and the speed, and the errors and uncertainties of the results probably did not in any case exceed on the whole ½ per cent.

The surfaces used in the experiments were of yellow pine board, about $\frac{3}{16}$ of an inch thick, loaded at the edge with lead keels of the same thickness, fastened fair and flush with the board, the weights being such as to just neutralise the flotation, and hold the boards stably in a vertical plane. The head end (so to call it) of each board in turn was fastened into a tin sheath, or fine-edged cutwater, which formed a portion of the dynamometric apparatus, and which held the board resolutely in a vertical plane, with its length horizontal, and in the line of motion. The width of each board, including the lead keel, was 19 in., their lengths, including the cutwater, varied from 1 ft. to 50 ft. Great pains were taken, and successfully, to eliminate, and, indeed in effect to obliterate the resistance due to thickness.

It turned out that the effects of the three conditions under which the variations of the force were to be determined, could not be regarded as absolutely independent of each other, because certain variations in the quality of the surfaces were found to affect in some degree the relations of the force to the speed and to the length. The results may be approximately stated in brief, as follows :—

1. As regards the relation of resistance to speed. With the surface coated with shellac varnish, Hay's composition, or Peacock's composition, or tallow, the resistance varied very nearly as the power 1·83 of the speed; with the surface coated with tinfoil, very nearly as the power 2·05 of the speed; but the experiments with the tinfoil are not yet complete.

2. As regards the relation of resistance to quality of surface. With the surface coated with shellac varnish, Hay's composition, Peacock's composition, or tallow, the resistance differed extremely little; such variations as occurred scarcely exceeding 1 per cent., and being probably not greater than belonged to the small differences of smoothness in the laying on the composition.

With the surface coated with glue, and thus simulating the sliminess of a living fish, three successive experiments were tried at the same speed, so as to test the effect of the gradual growth of the slimy character. The first experiment showed an increase in resistance of 2 per cent., the last of 4 per cent., as compared with the shellac surface which the glue resembled before immersion, a proof that the attempted imitation of the fish's surface was not advantageous.

Comparing a tinfoiled surface with one coated with shellac, when the length is 1 ft. the resistance of the former is on the average only $\frac{35}{36}$ that of the latter, making the comparison with planes of 1·6 in length, the ratio is $\frac{3}{4}$, and with planes of 16 ft., more than $\frac{9}{10}$, instead of $\frac{35}{36}$; indeed, the total difference becomes progressively less as the planes compared are longer. At higher speeds also the difference tends to become less, in consequence of the higher power of the speed to which it is proportioned with the tinfoiled surface.

3. As regards the relation of resistance to length of surface. There plainly is a very considerable diminution of average resistance per square foot as the length of surface is increased, and this probably from the course already indicated, though the *rate* of diminution becomes gradually less as the surface becomes longer; there is, in fact, as great a diminution between 3 ft. and 4 ft. of length as between 30 and 50.

The following tabular statement gives the mean resistance per square foot on surfaces of from 1 foot to 50 feet in length, with speeds of from 200 to 800 feet per minute.

Length of plane. Feet.	Speed in feet per minute. 200	400	600	800	Resistance in pounds.
1	0·048	·200	·460	·830	
2	·045	·188	·413	·725	
3	·043	·183	·390	·673	
5	·042	·166	·358	·608	
7	·041	·154	·333	·563	
10	·040	·145	·312	·529	
20	·036	·131	·278	·473	
30	·035	·123	·264	·446	
50	·035	·117	·250	·417	

The table is applicable to a clean planed surface coated either with shellac varnish, Hay's or Peacock's composition, or tallow.

SCIENTIFIC SERIALS

Proceedings of the Newcastle-on-Tyne Chemical Society, 1871-72.—The number of meetings held by the society during the past year has been 6, the session only lasting from October to March with one meeting in each month. The October number opens with the address of the president, Mr. John Glover, which contains a short review of the papers read before the society during the previous year. The first communication is one which does not seem to have attracted the attention which it deserves; it is by Messrs. Pattinson and Marreco "on the residual sulphur in purified coal gas," that is to say, the sulphur contained in coal gas after the removal of the sulphuretted hydrogen by means of oxide of iron or by lime. At various times violent fluctuations have taken place in the amount of the residual sulphur in the gas supplied to Newcastle, the quantity varying from 25 grains in the 100 cubic feet down to 4 grains. The authors believe that the explanation of this lies in the fact that the lime purifiers then in use were sometimes allowed to become "foul" or acted on to a great extent by the sulphuretted hydrogen, &c., contained in the crude gas. Contrary to what might have been expected, when some of the purifiers had become foul, the quantity of sulphur decreased rapidly, but that when the foul lime was replaced by clean lime, the quantity of sulphur immediately rose to some 25 grains per 100 cubic feet. An example is given of an occasion when clean lime was placed in the boxes, the amount of residual sulphur in gas was found to be 17·58 grains, and that as this lime became foul, the succeeding weekly tests gave 12·10 and 6·69 grains respectively. The method employed for the estimation of the sulphur is not stated; it is to be hoped, however, that one of the more recent methods has been adopted, and not the "Letheby sulphur test," which, as is well known, gives at the best, most inaccurate results. According to the authors it would seem a simple matter for our large gas companies to considerably reduce the quantity of sulphur present in gas, at comparatively no expense to themselves. The probable chemical action which appears to take place is the formation of a sulphocarbonate from the combined action of the carbon disulphide in the gas and the foul lime. Most of the remaining papers possess principally a technical interest. Amongst these we notice one "on the action in the black salt-pan and calcining-furnace in alkali manufacture," by Mr. Moorhouse, and "on a new mechanical calcining-furnace" by Mr. Gibb, who also contributes a paper "on the formation of sodic carbonate by the action of carbonic anhydride on solutions of sodic sulphide." Dr. Lunge also contributes the abstracts of two papers by Fresenius, the first "on the quantitative estimation of sulphuretted hydrogen in presence of carbonic anhydride," and the second "on the best method of analysing artificial manures." This latter paper should be read by all interested in artificial manures, and will well repay a careful study. One feature to be noticed at the meetings of this society is that there is almost always a spirited discussion on the papers read, which shows very well the interest taken by the members in promoting the advance of chemistry, and also the welfare of their society.

Annali di Chimica applicita alla Medicina compilati del Dottor Giovanni Polli, No. 4, 1872. The contents of this number is of varied interest, the papers being grouped together under various heads, such as pharmacy, toxicology, therapeutics, &c., are very easy of reference. Under the head of pharmacy there are several papers given, which are abstracts of papers already published in other countries, such as "On the determination of the value of chloral hydrate," "On a new reaction of alcohol," by Berthelot, and others. Amongst them there is a note on the adulteration of essence of peppermint, which is now adulterated with the essential oil of copaiba; there is a second note on the adulteration of argentic nitrate with zincic nitrate, the amount of which, in some specimens, leaves no doubt of its having been introduced with fraudulent intention.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences.—October 3, 1871.—Dr. Ruschenberger, president, in the chair.—Mr. Thomas Meehan referred to some observations made by him last spring before the Academy in regard to the office of bud scales and involucral bracts. The general impression was that they were formed for the purpose of protecting the tender parts beneath. At that time he exhibited branches of *Fraxinus excelsior* on which some of the buds were entirely naked, and others clothed with scales in the usual manner. They could scarcely be for protection in this instance, as both were equally hardy. He now had to exhibit an ear of corn which had been produced without the usual involucral bracts or husks, and yet was as perfect as if clothed in the usual way, showing that the husk was of not much importance as a protecting agent. An interesting point was that this ear had been formed on the end of a male panicle or tassel. It was not uncommon to find scattered grains of corn amongst male flowers, but a perfect ear like this he had never before seen. The ear was eight-rowed, and contained two hundred perfect grains. It was the variety known as "popcorn."

November 7.—Dr. Ruschenberger, president, in the chair.—Prof. Cope exhibited a specimen of a *Galeodes*, probably *G. pallipes* of Say, taken in the town of Denver, Colorado, by Dr. Gehrung. According to that gentleman, it was common in that place in houses, and was an enemy and destroyer of the *Cimex lectularius* (bedbug). In captivity, it showed a preference for them as food, and crushed them in its short cheles, preliminary to sucking their juices.—Mr. Thomas Meehan said that while travelling through a wood recently he was struck in the face by some seeds of *Hamamelis virginica*, the common Witch Hazel, with as much force as if they were spent shot from a gun. Not aware before that these capsules possessed any projecting power, he gathered a quantity in order to ascertain the cause of the projecting force, and the measure of its power. Laying the capsules on the floor, he found the seeds were thrown generally four or six feet, and in one instance as much as twelve feet away. The cause of this immense projecting power he found to be simply in the contraction of the horny albumen which surrounded the seed. The seeds were oval, and in a smooth bony envelope, and when the albumen had burst and expanded enough to get just beyond the middle where the seed narrowed again, the contraction of the albumen caused the seed to slip out with force, just as we would squeeze out a smooth tapering stone between the finger and thumb.

BOOKS RECEIVED

ENGLISH.—Memoirs of the Geological Survey of England and Wales. Vol IV.—The Geology of the London Basin: T. McK Hughes (Whittaker).—Autumns on the Spey: A. C. Knox (Van Voorst).—A Handbook of British Birds: J. E. Harting (Van Voorst).—A Handbook of the Birds of Egypt: G. E. Shelley (Van Voorst).—Thoughts and Meditations on the Mysteries of Life. Book I: John Frith (Trübner) — Physical Geography: S. P. J. Skertchley (Murphy).—The Sea-weed Collector: Shirley Hibberd (Groombridge and Sons).—Flora of Liverpool (the Liverpool Naturalists' Field Club).—Human Physiology: W. T. Pilter (J. Kempeter).

CONTENTS

ERRATA.—Vol. vi., p. 361, 1st col., line 17, for "meeting" read "heating;" line 19, for "illuminated" read "eliminated."

NOTICE

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