THURSDAY, SEPTEMBER 14, 1882

NAVAL EDUCATION

FROM the papers and discussions which have recently appeared in the *Journal* of the United Service Institution (Nos. cvi., cxv., 1880, 1882), it would appear that a large number of our naval officers are becoming sensible of the many defects of the system under which their younger brethren are at present entered and educated. In all professions it is so much the custom of the seniors of high rank to hold by the existing state of things, that the protest now made is the more marked, coming, as it does, not from one officer, or from a clique, but from officers of all ages, ranks, and branches, who look on the subject from different points of view, and correct their judgment by different forms of experience. The fact seems to be that, whereas the naval officer of former days was not called on to be anything but a seaman, though it was no doubt better if he was also a gunner—which was but seldom—at present he ought to be not only a seaman and a gunner, but half-a-dozen other things as well—a navigator, an engineer, a mechanic, an electrician, something of a soldier, something of a naval architect, skilled in signals and in tactics, and not ignorant of international law. There are, of course, but few who can excel in all these branches of knowledge; but every naval officer is expected to know something of all, and before getting his commission he has to show, in examination, that he does know something of all, even though that something may occasionally be very little: he is then permitted to choose one or two subjects of which he may make a specialty; he may devote himself to navigation, to gunnery, or to the management of torpedoes; and on showing that he possesses special qualifications, he receives special appointments and a higher rate of pay. But whether his tastes and abilities lead him to qualify in these special subjects or not, he is supposed to have a certain respectable knowledge of all; and, as keeping up the traditions of the service, he is required, before everything, to be a first-rate seaman. The most important question then is, Does the present system of training young officers ensure their becoming first-rate seamen? The answer of almost every speaker at the United Service Institution is in the negative. Capt. Brine, to whom the Institution has this year awarded its gold medal, says, "A midshipman serving in an ironclad has but few opportunities of learning the work of a sailor; it cannot be said that the years thus passed are essentially valuable as regards seamanlike training." Capt. Grenfell says, "We are all familiar with Falconer's admirable picture of the almost child handling a ship—'And well the docile crew that skilful urchin guides.' It would be useless to look for the same thing now. Our urchins, we must confess, are not "skilful." Capt. Cleveland says, "On board an ironclad, youngsters have very little opportunity of learning more than just the routine work, which they may learn from a book;" and Lord Dalhousie thinks "the ordinary life of a midshipman in a sea-going ship to be so ill-organised as to be little better than very laborious waste of time, so far as his own professional training and education are concerned." Many others might be quoted to the same effect, for the agreement is almost perfect; but these are sufficient. It may be assumed as admitted that a little boy sent on board an ironclad to learn seamanship, does not learn it, and has no opportunity of learning it, whether seamanship is understood in the old sense of handling a ship under sail, or in the modern sense of handling her under steam, and still less if in the strictly logical sense of "manœuvring ships under all circumstances of wind and weather." What our large ironclads have masts and yards for—except to foul and choke the screw in time of battle—is a thing often wondered over. Many have none, and even those that have them do not trust to them in performing the simplest nautical evolution. Clearly then a young gentleman on board such a ship does not learn the sailoring of the old school. How he can be supposed to learn the management of the ship under steam does not appear. Capt. Cleveland—who, as having lately commanded an ironclad, speaks with a special authority—says, "No captain would ever trust an ironclad to a young gentleman to work, as the captains of old did their frigates;" and evidently the mere being on board whilst somebody else is working the ship can teach him very little. His principal duties are, in fact, said to be seeing the ashes emptied overboard, the decks swept, and the brass rails polished; niceties which he might learn equally well on shore from his mother's housemaid, or by making an occasional round in the dust cart. Mr. Laughton, one of the Instructors at Greenwich, goes so far as to doubt whether this method of training young officers was ever quite satisfactory. "No doubt," he says, "in former days the still existing system of sending little boys on board ships on active service to learn seamanship by doing what they were bid and keeping their eyes open, answered *pretty* well. I do not think it did *very* well. Of course we turned out a large number of first-rate seamen, but it was out of an enormous number of entries. No account can now be taken of the failures; but of those who through ignorance, drink, and immorality went wholly to the dogs, the number was extremely large, and of those who did not thus utterly break down, there were a very great many who dragged on in the service as ignorant of seamanship as of everything else that was reputable." Even now the same evils are at work, though in a less degree; and in a former paper on a kindred subject, Mr. Laughton showed that "more than half the entries into the service disappear within twelve years," whether from "death, ill-health, family affairs, dislike, incapacity, or bad conduct."

Now it has long been maintained that the early lessons in seamanship, in the management of the ship and the men, were a sufficient and imperative reason for dragging little children off to sea. But since it appears proved by the concurrent testimony of many Admirals, Captains, and Commanders now serving, that our children so sent to sea do not learn seamanship, and that our young officers are thus, as a rule, curiously ignorant of real seamanship when they go up for their examination, this alleged sufficient reason falls to the ground; and many other reasons, which do not fall to the ground, prove that the system is a bad one. Let it be borne in mind what this system is. Little boys between the ages of 12 and 13½ years are selected by limited competition in an examination which Admiral Boys—himself for some time the Superintendent of the College at Portsmouth—describes as "simply an examination of their mothers or governesses, or the preliminary schools they may have been at." Their general education is then stopped; they are sent to the *Britannia*, and there, in the space of two years, they have to learn and pass an examination in a number of subjects, the list of which is utterly appalling. On this Prof. Soley, of the United States Naval College, says, "The course, as indicated by the examination papers, is far in advance of the mental powers of average boys of the prescribed age. The reason that more do not fail is to be found in the low standard of passing, and in the system of cramming carried out by clever tutors who are masters in the art of coaching pupils for examinations. No one seems to pretend that the students come anywhere near the ostensible standard, or carry away anything like real knowledge of the subjects embraced in the programme." And what little is learnt is extremely evanescent: within six months the majority have forgotten all about it. It appears from a report by Dr. Hirst, the Director of Studies, that in a recent examination, and in papers specially prepared, the young gentlemen six months out of the *Britannia* obtained an average of 32 per cent. in Arithmetic, 28 in Algebra, and 17 in Trigonometry. Now the *Britannia* is essentially a mathematical school, and the Instructors are —it is fully proved by their immediate results—able, hard-working men; but they are crushed by a radically bad system, which necessitates the "teaching mathematics and navigation from the wrong end." In this, the Instructors have no option; they are bound by an official schedule which requires the newly-caught children, knowing next to nothing of Algebra or Geometry, and very little of Arithmetic, to proceed at once to the solution of Plane and Spherical Triangles. Of course the little fellows learn to do these questions, because there is no passing for them unless they do do them; but "the knowledge is stuffed into them by a 'damnable iteration' sickening alike to the teacher and the taught." What is the result? We have shown that they pass out of the *Britannia* and straightway forget it all. A Naval Instructor of many years' experience assures us that his guiding rule has been to assume that a youngster joining his ship fresh from the *Britannia* knows nothing, and to begin him with the very elements of Algebra and Geometry. When this can be done, when the Naval Instructor is zealous and is supported by the Captain, when a suitable place can be found for study, and when the youngsters are industrious and clever, then, no doubt, very satisfactory results are sometimes obtained: but the difficulties in the way are exceedingly great. "Order it as you will," Mr. Laughton says, "on board ship the routine will always interfere with the school, and interruptions are frequent. Nor does keeping the middle or morning watch quicken a boy's faculties for study: with his eyes involuntarily closing, his head nodding over his book, the thermometer at 80° or 90°, and the perspiration dropping from the end of his nose—the difficulties in his way are very real. What a make-believe school, under such circumstances, often is, every Naval Instructor knows very well. The wonder is not that, with such a considerable expenditure of labour, so little is done, but that anything is done at all." The present day affords an example of another difficulty. What amount of school, we would ask, have the young gentlemen of the Mediterranean fleet done during the last three months? or, admitting that in some instances they have been present in the body, what amount of real study have they done? Our experience of boy-nature would lead us to answer—None. And after all these difficulties, the end is as might be expected: for a young officer in his final examination to show any real knowledge of his theoretical subjects is said to be quite exceptional.

The result then of the present system is that—speaking generally—the young officer, whilst a midshipman, learns neither the practical nor the theoretical parts of his profession: his time is muddled away: he gets a certain amount of crude knowledge crammed into him for his examination; and having passed that, if all desire of learning has not been crushed out of him, he has too often to begin again at the very beginning. In the majority of cases, Mr. Laughton tells us, an officer coming to the College for a voluntary course of study "does not know any mathematics at all"; and, he adds, "when men have got to the age of 25 or 30 without mastering the elementary principles of geometry and algebra, the task of then doing so is extremely irksome, and in many cases, utterly impossible." Now it is admitted, and—as we have said—by officers of long and special experience, that this state of things does exist, and ought not to exist; and there seems a very general idea that the remedy must be a radical one, and be applied at the beginning; that the foundation of mathematical knowledge ought to be laid before a boy goes to sea at all; and that the early part of his time at sea should be spent in a specially appointed training ship, and not in a ship on active service, where the instruction of the young officers is a point of very secondary consideration, if indeed it has any real place. Mr. Laughton proposes that the cadets should not be entered till they have learned their mathematics, and suggests that this should be tested, in a competitive examination, at an age ranging from 16 to 17. Capt. Grenfell would prefer entering them by nomination at 12, and keeping them in a college under the Admiralty for 4 or 5 years. Each proposal has its own advantages; but we prefer a free competition, at a reasonable age, to the nomination of children; and we see no reason why these elementary subjects should be taught, at the expense of the public, to lads who are in no way bound to the public service. But either one, or the other, or any similar scheme would be an enormous improvement on the present system, which stands condemned by its acknowledged failure, and by the verdict of a very large number of experienced officers.

UNITED STATES FISHERIES

Report of T. B. Ferguson, a Commissioner of Fisheries of Maryland, January 1881. (Hagerstown, Maryland: Bell and Co.)

THE figures of fish culture as we find them in the various reports of the American fishery commissioners are perfectly startling in their magnitude. In this report of Major Ferguson we are favoured with an account of the piscicultural work carried on in connection with the "Shad" (*Alosa sapidissima*), an excellent food fish, which is now being bred in millions at several places in the United States. A table of the numbers of these fish which have been brought to market, being the yield from the Potomac River only, shows that the catch in fifteen years, namely, from 1866 to 1880, amounted to 10,621,444 individual fishes. The averages captured in periods of five years were as follows :—

First five years	(1866-70)	... ...	870,109 single shad.
Second ,,	(1871-75)	... ...	874,114 ,,
Third ,,	(1876-80)	... ...	380,065 ,,

These figures are instructive. The shad fishery, as demonstrated by the number of fish marketed at Alexandria and Washington, seems to have culminated in 1873, when the numbers offered for sale were 1,142,629 individual fish. After that year the supply begins to fall off, till in 1878 the figures are reduced to 166,923 single shad. The fluctuations of various years can be accounted for in different ways to some extent, but as the Commissioner says: "We must recognise in these statements the inevitable result of successive years of over fishing; of disturbing the fish on their spawning beds; and of preventing them from reaching such beds." The ease with which all kinds of fish can be treated pisciculturally has been a really important discovery for the American people, because there has begun all over the United States a sensible, and in some instances a very marked, decline in the supply of nearly all kinds of fish, even the salmon—in that great depository of these fine fish, the Columbia River—are diminishing in numbers, consequent upon the incessant capture. It is gratifying therefore to learn from the present report that there need be no bounds put to the increase of our food fishes, and to be told that fishes inhabiting the salt water exclusively can be as readily propagated artificially, and increased to as unlimited an extent as the "anadromous fishes," with whose spawning habits we are more thoroughly acquainted. We have at home been accustomed to look with feelings of wonder on the hatching of a hundred thousand salmon eggs as if that were a sort of miracle, but the record of the shad hatching operations given by Major T. B. Ferguson sinks into insignificance anything that has yet been accomplished in the way of "pisciculture" in Great Britain. In a period of some fifty days, upwards of twenty million eggs of the shad were obtained, and over eighteen millions of these eggs came to life as fish! These young fish were all safely deposited in waters where they had a good chance of growing to maturity and ultimately contributing to the national commissariat. It would seem to be a leading idea of those who have the largest say in the regulation of the American fisheries that it is better to multiply the fish by means of what is known as pisciculture than to restrict in any way the operations of the fishermen during the legitimate fishing seasons; so long as the work of the pisciculturists can keep pace with the work of the fishermen there can be no objection to the occasional glutting of the markets with such wholesome food.

We learn from a portion of Mr. Ferguson's report that there are on the Atlantic Coast of the United States nine fishes belonging to the herring tribe. Although no special hatching station has yet been established for the propagation of the Clupedia, it has been ascertained that like other fish they can be operated upon "pisciculturally," and many hundred thousand eggs of these fish have been hatched by way of experiment, the newly developed fry being at once restored to the water. Some varieties of this fish are of great commercial importance, and will doubtless at once attract attention, as being capable of being bred in millions on the artificial system. Indeed the Menhaden has been already so operated upon with great success.

Some interesting details are given by Major Ferguson of the piscicultural work done in connection with the carp and landlocked salmon. Great interest has been taken in carp culture throughout the United States. The original stock of carp from which all supplies have been obtained, were imported by Prof. Baird, of the Smithsonian Institution, some years since from the best ponds of Europe—chiefly from Germany; the "leather" or scaleless variety is held in most esteem. It appears that the carp has been acclimatised in America with great success, increasing in bulk year by year with almost phenomenal rapidity, the ratio of growth being truly remarkable. This is accounted for by the great abundance of their natural food which these fishes find in American waters, and by that comparative mildness of the weather, which affords them a much longer feeding season than they have in their native country. During their spawning season, great pains are taken to procure the eggs of these fish; they are, however, allowed to spawn naturally, but the twigs and blades of grass on which the ova found a resting place were at once removed to ponds which had been prepared for their reception, where the eggs speedily came to life. The carp have been extensively distributed over the States of America in small numbers—from ten to twenty pairs only being given to applicants, but the fish has multiplied exceedingly, so that in the course of another year or two the carp will be quite a common fish throughout the United States. "This fish," says the report, "is so admirably adapted for domestic purposes, that every one in the State who has even a small pond, such as is usually devoted to the collection of ice, should prepare it for rearing the carp, which, being largely a vegetable feeder, can be raised at very little expense, and can be utilised for the consumption of the waste of the kitchen garden." It is interesting to know that a war of extermination had to be entered upon to get rid of the kingfishers: these feathered robbers having played havoc among the young fish. The "golden ide," from its conspicuously brilliant colour, became the chief prey of the birds.

Among the miscellaneous fishery work mentioned in the present report is the hatching of 200,000 eggs of the Californian salmon in floating boxes in the north branch of the Potomac, near its source. The fry were protected till the umbilical sac was absorbed, when they were liberated to shift for themselves; it will be interesting to know how these fish progress. So far as it could be carried, the experiment was greatly lauded by experts in fish culture. The reporter is in favour of movable hatching boxes, being convinced that "by means of such apparatus our streams can be much better stocked with Salmonidæ, than by the systems hitherto pursued of developing the eggs in hatching houses and transferring the young fish thence."

The remainder of the report is devoted to a long treatise on the oyster, and an account of experiments on oyster culture, which we have not space to discuss in the present number.

OUR BOOK SHELF

Wanderings South and East. By Walter Coote. Maps and Illustrations. (London: Sampson Low and Co., 1882.)

Pioneering in the Far East, and Journeyings to California in 1849, *and the White Sea in* 1878. By Ludwig Verner Helms. Illustrations. (London: Allen and Co., 1882.)

ALTHOUGH these two volumes cover a very wide field, neither of them can be said to break on new ground. Mr. Coote does not profess to be much more than a tourist, but as he tells the story of his wanderings pleasantly, and touched at a few places concerning which our information is scanty, he may be held to have sufficient excuse for bringing the record of his journey before the public. He spent some time in the Australian Colonies and Fiji, and visited Norfolk Island. His wanderings further embraced the Hawaiian Islands, the New Hebrides, the Banks and Torres Islands, the Santa Cruz and Solomon Islands, New Caledonia and the Loyalty Group. China and Japan, and Central and South America were also embraced in his extensive tour. Mr. Coote is a good observer, and the information he gives concerning what he saw in the less frequented islands, the New Hebrides, the Santa Cruz, Solomon and Loyalty Islands, is a welcome addition to existing knowledge. He is chiefly interested in the people, habits, houses, implements, and weapons, and therefore the ethnologist may find something in his volume that will be of service. The illustrations are good, and the volume as a whole is extremely pleasant reading.

Mr. Helms is an old traveller, and most of his volume takes us back about thirty years ago. He spent considerable time in Bali and Borneo, where he took a prominent part in the events connected with Rajah Brooke; visited Cambodia and Siam, China and Japan, and spent some little time in California during the height of the gold fever. He brings together much curious and interesting information about Bali and Borneo, especially at the time of his sojourn, the condition of the people, their manners and customs, the state of trade, &c. He gives a very vivid description of an instance of suttee which he witnessed. His account of what he saw in California is interesting, and he finishes off with the record of a visit to the White Sea, in connection with some mining operations. Altogether his book is quite worth reading.

Hölzel's Geographische Charakter-Bilder für Schule und Haus. Herausgegeben unter Pädagogischer und Wissenschaftlicher Leitung, Von Dr. Josef Chavanne, K. v. Haardt, V. Prausek, Prof. V. Marilaun, Dr. Fried. Simony, Dr. Fr. Toula, Dr. K. Zehden, &c. (Vienna: Edward Hölzel, 1882.)

WE have already referred, in connection with Hirt's Geographische Bildertafeln, to the comprehensive idea of geography entertained in Germany, and the admirable methods adapted for infusing into the teaching of the subject as much of reality as possible. For enabling the pupil to realise the features about which he reads in his text-books, we have never seen anything to equal the Charakter-Bilder which are being issued by Hölzel of Vienna, and edited by a large staff of some of the best teachers. These pictures are on a very large scale, are coloured by the oleographic process, and have all the appearance of good oil-paintings. Each picture is devoted to one subject, and measures something like 2½ feet by 2 feet. The aim is evidently to illustrate the leading features of the earth's surface, and bring before the pupil the main characteristics of the different countries. Nine of these pictures have already been published; their subjects are the Ortler Region, the Shoshone Cañons and Waterfalls of North America, the Gulf of Pozzuoli, the Sahara Desert, the Bernese Oberland (a double picture), the Rotomahana Region of New Zealand, the Sierra Nevada, the Eastern Border of the Anahuac Plateau. Thus, it will be seen, the subjects are very varied. To each picture there is a separate explanatory text, entering with somewhat minute detail into the characteristics of the region illustrated, its topographical features, geology, biology, &c.; the text being accompanied with wood engravings still further to help in the understanding of the subject. We need scarcely point out what an important help these pictures and their text must be in the study of geography, nor how admirably calculated they are to lead children to interest themselves in the subject. To the household library they would be an important addition, and even those who have long left school might turn them over with pleasure and profit. We should like to see them brought within the reach of English schools.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Researches on the Division of the Chlorophyll-Granules and upon the Occurrence of Hypochlorin in the Cyanophyceæ and Bacillariaceæ

I, IN the year 1881, made a considerable series of examinations of the division of the chlorophyll-granules of phanerogamous and cryptogamous plants, and upon the occurrence of Pringsheim's hypochlorin in the lower algæ, especially in the order Bacillariaceæ and Cyanophyceæ (Phycochromaceæ). The investigations are in detail described in my paper, "A chlorophyll és a növényi sejtmag morphologiájához. Irta Schaarschmidt Gyula. Rajzokkal egy photogrammon. Kolozsvárt, K. Papp Miklós örököseinél, 1881. 56 pp. 16°" (Contributions to the Morphology of the Chlorophyll and Vegetable Nucleus. With photograms. Kolozsvár, 1881, &c.), which is published in the Hungarian language. I take the liberty of briefly communicating the chief results, by way of insuring my priority.

I. The division of the chlorophyll-granules was discovered by Carl Nägeli in the year 1844. After him Milde, Wigand, Hofmeister, Rosanoff, Sachs, Kny, Strasburger, Velten, Haberlandt, Mikosch found that the chlorophyll-granules multiply by division in the lower and the higher plants. According to these authors, the granules are divided by a constriction in the middle; the green colouring-matter retires to the poles; consequently the protoplasmatic isthmus between the daughter-granules is colourless. The new daughter-granules increase in size, until they become as large as their parent-granules. When detached, each divides again, and the process is repeated. But the process is, according to my observations not so simple. We find here an example of division that is very similar to the multiplication of the nucleus described and drawn by Hanstein, Strasburger, &c. The green colouring-matter retires before the division to the two poles of the oval-shaped granules, and in the middle a colourless band is thereby formed. In this state will be seen with powerful lenses (2000–3000 lin. magn.), and by careful preparation with alcoh. abs. and tinction of anilin, that in the protoplasmatic isthmus small threads (filaments) are formed. The extremity of the threads is immediately fixed in the protoplasmatic matter of the granules. If we examine the double granules, which are now lying detached at a little distance (united solidly by the threads), we see the threads between the daughter-granules expanded. This figure reminds us of the state of nucleus division called "cell-tun" (*Zell-Tonne*) by Strasburger. The new daughter-granules separate further and further; the threads are more and more extended, until the intervening space equals that occupied by two to three granules. During this time the inner portions, as they extend, develop more and more of the circle, until each becomes a perfect hemisphere. The daughter-granules are separated by the growth itself and by accident, and the division is determined by the dilaceration of the threads. The young granules increase in size, and acquire their normal figure. After the division, there may be found upon the granules a few protoplasmatic hyalin cilia, divided in groups. These cilia are the remainder of the divisional threads. All these cilia spring from points where dark spots are seen upon the surface of the living granules. The compressed granules of Hartwegia, of Fern-Prothallia, of Vallisneria, and Elodea offer most favourable opportunities for ascertaining the manner of division. This singular process is repeated again and again, so that the older granules are compressed, and a filament is formed, which elongates more and more rapidly as the granules increase in number. Sometimes the filament may be ramified. This continued multiplication by division has its limits; the protoplasmatic bearer (the matter of the granule, which carries the colouring substance) changes its appearance, and contains starch-granules, which soon become numerous. The whole process cannot, of course, be seen in the same granule, but in some, dividing granules may be observed in one stage, and in others in another. In such a manner (though the process is not so clear) divides the endochrome of the Bacillariaceæ, as I have studied it, in *Himantidium pectinale*. That is the manner of division certainly most common. The second mode of multiplication by division is more simple. The granules are divided by a constriction, and separate into single granules; the daughter-granules become detached after they have reached their full form and size. No cilia or threads, only a small number two to three (not six to eight) are formed by the division in the isthmus between the half-granules. This division is a reduced form of the former, that is, the direct division without cilia; the former is the indirect division with cilia. The direct division I have studied in all higher and lower green plants in all seasons of the year. The second form, the direct division, is seen especially in the cells of Vaucheria and Chara. These changes in the division of chlorophyll-granules of which we speak, can only be observed with a considerable magnifying power (2000–3000 lin. mag.), that is the cause why Mikosch agrees with the other authors mentioned in disclaiming the notion of threads of the true mode of division. I ascertained these changes in March of the year 1880, and described them in a short notice in the *Magyar Növénytani Lapok* (Hungarian Journal of Botany, edited by Prof. Dr. Kanitz Kolosvár (vol. iv. pp. 32-43).

II. Prof. Pringsheim,[1] after ascertaining the occurrence of hypochlorin in all higher chlorophyllous plants, and in many green algæ, speaks in his paper, with reference to the Bacillariaceæ, "Sie fehlt (the hypochlorin) dagegen bei den nicht chlorophyll grünen Gewächsen; also bei den Phycochromaceen, Diatomeen, Phæosporeen. . . . Wenigstens konnte ich sie bisher in den genannten Pflanzengruppen noch nicht sicher nachweisen und nur Spuren derselben ist es mir geglückt, in manchen Entwickelungsstadien einiger *Diatomeen aufzufinden*." I have, with the use of diluted muriatic acid, proved the occurrence of hypochlorin in all the Bacillariaceæ and Cyanophyceæ (Phycochromaceæ) investigated. The experiment succeeded best with *Calothrix scopulorum*. The hypochlorin was seen in all these plants in the typical form of brown scales or brown drops.

SCHAARSCHMIDT GYULA

Botanical Institute of the Royal Hungarian University, Kolosvár (Hungary), August 3

Mimicry in the "Plume Moths"

I HAVE not seen in any entomological work an attempt to explain the well-known peculiar character of the wings of the "Plume Moths" (*Pterophori*). They depart so thoroughly from the rest of the Lepidoptera in having the wings cleft into so-called feathery "plumes" (although retaining the microscopic scales characteristic of their order), that we may be certain so marked a type must have been evolved along definite lines and for specific reasons. One species (*Agdistes Bennetii*) may be regarded as the first stage in the differentiation of these insects; and from this species we have successive modifications in the number of "plumes" up to *Alucita polydactyla*, where the ordinary wings are split up into no fewer than twenty-four.

I have long thought this wing-peculiarity is due to *mimicry*, the objects mimicked being the down or *pappi* of thistles and other composite plants. The commonest of the "Plume Moths," perhaps, is the "Large White Plume" (*Pterophorus pentadactylus*), and all entomologists are acquainted with its peculiar *drifting* mode of flight, exactly resembling that in which a thistle plume is blown by the wind. The other day I followed what I took to be a drifting thistle-plume, for the sake of seeing what species it belonged to, and found it to be a specimen of this species of moth, so remarkably similar do the two objects appear when in motion. If the intention of the "plume-moths" is to mimic the *pappi* of winged-seeds, we can understand why these insects do not fold the wings to the body when at rest, but seem to display them to the utmost instead.

The fact that (according to Stainton), out of about twenty species of *Pterophori*, the larvæ of which have their food-plant given, no fewer than ten feed on composite plants, or plants bearing plumed seeds, indicate that the resemblance of the winged insects to pappi must also be protective to females when depositing their eggs on plants which produce down, as well as when they are flying. It would be interesting to compare the different kinds of thistle and other down with the appearance of the various species of "plume-moths" which thus appear to mimic them.

J. E. TAYLOR

Ipswich Museum, September 5

NOTE ON SOROCHE (MOUNTAIN SICKNESS) IN THE ANDES

THE effects of diminished atmospheric pressure on the human economy seem to vary so much with different individuals that a few facts of personal experience may be of some interest to those who have attended to the subject. During a somewhat prolonged acquaintance with mountain travelling, I had never felt any of the symptoms described as characteristic of mountain sickness. The only effect of rarified air that I had been able to verify was that an equal amount of mechanical effect produced at a great height necessitates a greater effort, so that climbing or other muscular effort causes, *cæteris paribus*, more sense of fatigue. Being in Peru in the month of April last, I was about to avail myself, with a friend, of the opportunity afforded by the reopening for traffic of the Oroya railway, and to spend a few days at Chicla, the present terminus of that remarkable work. The height of Chicla above the sea is 12,200 feet, and we were assured by several residents in Lima that we should infallibly suffer from the *soroche*, the local name for mountain sickness in Spanish America. Not having ever experienced the slightest inconvenience at heights considerably exceeding that limit in the Alps, I treated these warnings with some derision, and in truth they had passed from my mind on the evening when I arrived at Chicla. I may say at once that neither there nor anywhere else have I experienced any of the symptoms of mountain sickness by day, or while up and moving about after dark. On the evening of our arrival, after a frugal supper we retired to bed about eleven o'clock. Soon after falling asleep, I awoke with a severe headache, which continued throughout the night, allowing only a few short and broken snatches of sleep, but which passed away soon after I rose somewhat before sunrise. On comparing notes with my friend, I found that he also had suffered from headache during the night; but as he is somewhat subject to that affection, he had not attributed it to any special cause, whereas with me it is most unusual.

The following day was spent in botanising on the steep slopes upon either side of the valley at Chicla, and as I was quite free from any inconvenient sensation, I attributed the headache of the previous night to some accidental cause rather than to diminished pressure. On the second night, going to bed about the same hour, I again awoke with a headache more severe than that of the previous night, and was altogether unable to sleep for the rest of that night. Some two or three hours after midnight I was suddenly seized with retching of the stomach, but, perhaps because my light dinner was fully digested, no further effect followed.

We had arranged for the succeeding day to ride to the

[1] Ueber Lichtwirkung und chlorophyllfunction in der Pflanze Jahrb. f. wiss. Bot. xii., 1851. Heft iii. p. 296.

summit of the pass where a tunnel for the railway was nearly completed before the troubled state of the country put a stop to the work. Owing to delays, usual in that part of the world, we were unable to start until ten o'clock. Partly on that account, and partly because snow had fallen during the night towards the summit of the pass, we resolved to halt at a point about 14,300 feet above the sea, and devote a couple of hours to the very interesting vegetation of that region. Although the path was not steep in that part, my horse, a spirited animal, already showed symptoms of distress, panting for breath and pausing at every few yards; but neither I nor my companion felt the slightest inconvenience during the day. On my return I fully expected some renewal of the symptoms of the preceding night, but to my surprise I slept perfectly on that as well as the succeeding night, as did also my companion. It seemed as if the ascent to a higher level and the return to Chicla had the effect of acclimatising us.

I should mention that on the first two nights we both noticed one further symptom of derangement of the functions in the extreme turbidity of the secretion from the kidneys, but this as well as the others disappeared on the third night. I failed to detect any disturbance of the respiration or the circulation, although my attention was specially directed to these which are the ordinary, but not invariable, symptoms of mountain sickness.

J. BALL

DREDGING IN THE NORWEGIAN FJORDS

BEFORE leaving this enchanting spot (Lervik on the island of Stordoe near Bergen) where, in company with Mr. A. G. Bourne, I have spent the month of August, I send a few hurried lines to give an outline of the results which a month's dredging and microscopising have yielded. Lervik was introduced to me by the Rev. Alfred Norman, who two years since found here, at a depth of 100 fathoms in the Hardanger Fjord (about five miles from Lervik haven), that very remarkable Polyzoan mollusc, Rhabdopleura. Mr. Norman originally discovered this organism off the Shetlands, and it has since been described from specimens observed in the Lofoten Islands by Prof. G. O. Sars, who was able to give a more complete account of it than had been possible for Prof. Allman, who described and named Mr. Norman's Shetland specimens preserved in alcohol.

During ten days of my stay here I have had the great advantage of the company of Mr. Norman, whose knowledge of dredging operations and of the northern marine fauna is unrivalled. My object has been to make a further study of Rhabdopleura upon fresh and living examples, and in this I have been successful. At first we found Rhabdopleura only at great depths attached to recently dead pieces of the beautiful coral, *Lophohelia prolifera*. But subsequently we have been able to dredge it and bring it in for study within an hour, having discovered it in water of only 25 fathoms depth at the mouth of the harbour where it occurs in the form of creeping colonies upon *Ascidia mentula*, and on dead shells. A body-cavity, tentacular skeleton, male reproductive organs, and various facts as to the mode of growth, gemination, and development of the polypides, are the new features which these specimens have so far brought to light, whilst they have also served to confirm in many important respects the description given by G. O. Sars.

Our next most important "find" has been a very interesting green-coloured Gephyrean, in all probability identical with the *Hamingia arctica* of Koren and Danielsen, known hitherto only by one spirit-specimen, described last year by the Norwegian zoologists, and by a second dredged here two years since by Mr. Norman, but as yet unnoticed. The published specimen appears to have lost its frontal process or appendage, which was perfect in the one dredged by us. The aspect of the complete worm is precisely that of a green Thalassema, from which, however, it differs most importantly in the absence of genital setæ, and in the structure of the cloacal nephridia, as also in the number and structure of the oviducts. Hamingia is also remarkable, as is *Thalassema neptuni* (which I obtained last year in quantity on the south coast of Devon) for having in its perivisceral fluid a large number of corpuscles deeply impregnated with Hæmoglobin, which give to the fluid a blood-red colour.

The special feature of the sea-bottom at depths of 100 fathoms and upwards, in these Norwegian Fjords, is the abundance of corals and Alcyonians. Nothing can exceed the delicate beauty of the white branches of *Lophohelia prolifera*, with which our "tangles" are always filled. *Amphihelia ramea* is nearly as frequent. *Allopora Norvegica*, a fine example of the Stylasteridæ made famous by Prof. Moseley, is also very abundant. But the most splendid of these coral forms is the *Paragorgia arborea*, of which we have taken a stem as thick as a man's arm, its branches spreading over three feet, and all (when living) of a perfectly uniform rose colour, as though modelled in wax of that tint. Allied forms—*Paramuricia placomus* and *Primnoa lepadifera*—are not uncommon, the latter affecting a bright salmon colour. The soft parts of nearly all these forms have yet to be studied in detail, and the preservation of samples in the approved reagents has been our special care.

Antedon Sarsii, *Rhizocrinus lofotensis*, *Neomenia carinata*, and *Chætoderma nitidulum* are amongst the scarce animals of exceptional interest which we have had the good fortune to dredge. On the other hand, *Terebratulina caput-serpentis* and *Waldheimia cranium* are very abundant in only thirty fathoms, and Mr. Bourne has commenced an investigation of their structure which has been hitherto neglected, probably on account of the marvellous completeness of the account given by Hancock of *Waldheimia Australis*, based though it was on the study of spirit-specimens. A first result is that Terebratulina is not monæcious, but males and females are distinct.

Amongst animals of common occurrence or of less interest from an anatomical point of view, we have taken the following, identified by Mr. Norman, who has himself a much longer list from this and other parts of the Norwegian coast. Of Echinoderms, *Psolus squamatus*, *Oligotrochus vitreus*, *Holothuria elegans*, *H. intestinalis*, *Echinocucumis typica*, *Echinus sphæra*, *E. Flemingii*, *Spatangus purpureus*, *Echinocyamus pusillus*, *Echinocardium ovatum*, *Goniaster Phrygianus*, *Porania pulvillus*, *Astrogonium granulare*, *Archaster Parelii*, *Luidia Sarsii*, *Solaster furcifer*, *Stychaster roseus*, *Cribella oculata*, *Asterias rubens*, *A. glacialis*, *Ophiopholis aculeata*, *Ophiocoma nigra*, *Ophioglypha lacertosa*, *O. albida*, *Ophioscolex purpurea*. Of larger Crustaceans, *Hyas coarctatus*, *Galathea tridentata*, *Munida Banfica*, *Hippolytus securifrons*, *Pandalus annulicornis*, *Pasaphæa Savignii*. Of Sponges there are a very large number which have never yet been examined; amongst those recognised were *Thenia Wyville-Thomsonii*, *Geodia norvegica*, *Thecaphora* (a "Porcupine" form), *Quassilina brevis*, *Asbestopluma* (a new genus of Norman), and other common forms. The Rhizopods include some very extraordinary and large forms, abundant *Haliphysema*, *Astrorhiza limicola*, many arenaceous species, and a black sausage-like organism attaining a length of one-third of an inch, the skin of the sausage, membranous with an emarginate aperture at one pole—the contents hyaline protoplasm with an immense number of large dark green granular corpusles embedded in it. Of the Nemertines and Chætopods, I will not venture to speak without library, and the list of mollusca would fill a whole column of NATURE. One word I would say in conclusion, namely, that were a real zoological station, similar to that of

Naples, to be established in Northern Europe, it would be difficult to find a spot so admirably fitted as Lervik, on account of the richness of its fauna, and especially in view of the fact that the deep-sea fauna is brought almost to the door by the peculiar condition of the fjords, dredging up to 400 or 500 fathoms being attainable a few miles up the Hardanger. E. RAY LANKESTER

Lervik, Stordoe, near Bergen, Norway, August 27

SCIENTIFIC RESULTS OF THE "JEANNETTE" EXPEDITION

THE last number (August 26) of *Der Naturforscher* contains a first attempt to lay down the scientific results of this expedition, in a paper by Herr H. Wichmann, based on the reports of Messrs. Melville and Danenhauer, and of the naturalist of the expedition, Mr. Newcomb. It is known that after having passed, on August 31, the wintering station of the *Vega*, the *Jeannette* sailed north, towards Wrangel's Land. But on September 5, when twenty miles north-east of Herald Island, she was frozen in, and during twenty-one months remained so, "the play of winds and currents." However drifted in different directions, she still advanced during all this time towards the north-west. The first wintering was north of Wrangel Land, which last proved to be a large island, and not a part of an Arctic continent as had been presumed. The precious observations on auroræ and magnetism which were made during the winter (about 2000 measurements) are unhappily lost, as well as extensive collections of birds and of deep-sea fauna. The depth of the ocean in these regions was everywhere very small—thirty fathoms on an average, with a maximum of sixty and a minimum of seventeen fathoms. The bottom was usually a blue ooze, with a few shells and sometimes stones, which seemed to be of meteoric origin.

The ship still drifted towards the north-west, and on May 17 a small island, called Jeannette Island, was sighted in 76° 47′ 28″ N. lat. and 159° 20′ 45″ E. long. It was a rocky hill, covered with snow, situated on the eastern flank of a high mountain. Two days later another island was discovered towards the west, and an expedition under Mr. Melville reached it, with many difficulties, and landed on it on June 3, 1881. It was called Henrietta Island, and is situated under 77° 8′ N. lat. and 157° 43′ E. long.; it is rocky, and 2500 to 3000 feet high; the rocks are covered with nests of birds, but the vegetation is very poor, consisting of lichens and mosses, and of one species of phanerogam; all the island was covered with a sheet of ice and snow 50 to 100 feet thick, and a mighty glacier reached the sea on the north coast. As is known, on June 13, under 77° 30′ N. lat., and 155° E. long., the *Jeannette* was lost, the depth of the sea being there 38 fathoms. The crew, divided in three parties, went south, but ten days later they perceived that, owing to the drift of the ice, they had still advanced 27 miles north-west, being under 77° 42′ N. lat. That was the highest latitude reached by the expedition. On July 9 they perceived land, and after a hard journey, reached it at a promontory they called Cape Emma (76° 38′ N. lat., 148° 20′ E. lat.). This island, which received the name of Bennett, is a high mass of basalt, covered with glaciers; the island was crossed by a party, after two days' travel, and the north coast proved to be more hospitable than the south; it has several valleys covered with grass, where reindeer bones and drift-wood were found; lignite was discovered on the south coast, and it is said that it would be quite useful for steamers. Dr. Ambler here collected fossils, as well as many amethysts and opals, but they were lost. The gulls were so numerous and so tame that hundreds of them were killed with sticks; the tides were regular, but very small, the level changing only two and three feet. The sea was free of ice in the west and south, and even in the north-west a "water-sky" was seen, so that M. Danenhauer supposes that Bennett Island would be a good starting-place for future arctic expeditions. It was only on August 30 that the expedition discovered the first traces of men on the Faddeyeff Islands; and its further advance towards the delta of the Lena is well known. The scientific results of the *Jeannette* expedition cannot be yet completely appreciated, observes Herr Wichmann, but the note-books and surveys of its members having been preserved, as well as a good part of the collections, it is to be expected that they will contribute to a great extent to increase our knowledge of this part of the Arctic Ocean. The discovery of three new islands confirms the statements of Sannirikoff, who stated he saw land from the Faddeyeff Islands, and renders probable the existence of a whole archipelago in that part of the ocean. The exploration of the fauna and flora of the New Siberian Islands, which never was done before during the summer, promises interesting results. The problematical *polynias*, which stopped the advance of the sledge parties of Hedenström, Wrangel, and Anjou are not due to some warm currents, such having not been noticed during the temperature-observations of the *Jeannette*; they are simple openings in the ice, such as are observed elsewhere. Finally, the search expedition must give most important corrections to the maps of the Siberian coast between the Olenek and the Yana rivers, which has not been visited for sixty years; the observations of the American expedition will correct many of the observations of Lieut. Anjou. We may add to these expectations of Herr Wichmann that, as the Arctic law that "each polar expedition safely reaches the points which were sighted by the preceding one," will probably be true also for the North Siberian Seas, we must soon expect new and important discoveries in that direction, now that the way was opened to explorers of those parts of the Arctic seas.

NOTES

WE regret to learn that M. Joseph Liouville, the editor of the *Journal de Mathematiques*, died in Paris on September 7 at the age of seventy-six years. For some time back he had retired from his editorship and appointed M. Resal, a member of the Institute, as his successor. M. Liouville was born in St. Omer, admitted to the Polytechnic School in 1825, and appointed in 1829 an engineer of the Ponts-et-Chaussées. He soon resigned in order to devote himself entirely to the study of pure mathematics. He was elected in 1839 a member of the section of geometry in the Paris Academy. In 1848 he was sent by the electors of the Meurthe to the National Assembly, where he supported Arago's policy. In 1862 he was appointed a member of the Bureaux des Longitudes.

A MONUMENT to Becquerel, the French electrician, will be inaugurated this month at Chatillon.

DR. LEMSTRÖM, of Helsingfors, begins to-morrow a series of measurements of terrestrial currents, which measurements will be continued the 1st and 15th of each month. They will be made on two telegraphic lines, one of which, between Torneo and Helsingfors, runs north and south, and the other, between Mariehann, on the Åland islands, and Kexholm, runs west and east.

THE Council of the Parkes Museum have just acquired new premises in Margaret Street, Cavendish Square, to which the museum is to be removed from University College as soon as the alterations and additions, which are now being made under the direction of Mr. Mark H. Judge, A.R.I.B.A., are completed. The new museum will consist of a central hall, suitable for meetings and lectures, a library and corridors, all lighted from the top and well suited for exhibition purposes. The meetings and lectures on sanitary and other matters connected with the health of the people, which were only occasional while the museum was at University College, will form a permanent feature of the institution when it is reopened in Margaret Street. It is expected that the museum will be reopened before Christmas, in the meantime communications may be addressed to the Secretary and Curator, Mr. Mark H. Judge, at 8, Park Place Villas, Paddington, W.

IN the Report of the Executive Committee to the General Committee of the Great International Fisheries Exhibition at the meeting on the 7th inst., it was stated that since the date of the last meeting of the General Committee the arrangements for the preparation of the Gardens of the Royal Horticultural Society for the reception of the Exhibition have been greatly advanced. The plans of the proposed buildings have been determined upon, and the details of construction are so arranged as to be economical and effective, and can with ease be extended in the event of more space being required. The total amount of space at present provided for by the existing and new buildings, will amount to 220,300 square feet. A sub-committee has been appointed to superintend the construction of tanks and aquaria, and all the necessary arrangements for the piscicultural department. Since the date of the last meeting the Committee have received highly encouraging notices of adhesion from several additional governments and colonies, one of the latest received being a highly satisfactory telegram, through the Foreign Office, from the Imperial Government of China. From several parts of France also the process of oyster cultivation, carried to great perfection in that country, will be well represented; and the exhibits promised from Hungary, Italy, and Germany, are such as the Committee feel will be in the highest degree interesting, whilst from Norway and Sweden, the Netherlands, and other countries, including the Chilian Republic, which enjoy the advantage of local committees sanctioned by the governments, the collective exhibits sent will of course approach perfection. The International Meteorological Committee, who recently held their Annual Conference at Copenhagen, agreed to forward to the Exhibition from their respective countries representations of the system of forecasting the weather. From the colonies, for the most part, very satisfactory replies have been received, and official arrangements have been organised in nearly all the colonies connected in any way with the fishing interest. In the list of special prizes the Committee have made large and important additions, notably the prize of 600*l.* for the best life boat, and have received from private individuals donations to cover a certain amount of the expenditure thus involved. Among the more scientific subjects for prize essays are the following:—The Natural History of Commercial Sea Fishes of Great Britain and Ireland, with special reference to such parts of their natural history as bear upon their production and commercial use. This would include natural history, food, habits, and localities fish frequent at different seasons, and artificial propagation—100*l.* (This will not include Salmonidæ). On Improved Facilities for the Capture, Economic Transmission and Distribution of Sea Fishes, 100*l.* On Improved Fishery Harbour Accommodation for Great Britain and Ireland, indicating the localities most in need of such Harbours, the general principles on which they should be constructed, and the Policy the State should adopt in aiding and encouraging Harbour Accommodation for fishing purposes, 100*l.* The best Appliances and Methods of Breaking the Force of the Sea at the Entrance to Harbours and elsewhere, 100*l.* On the Food of Fishes both in Fresh and Salt Water, accompanied by illustrations and Preparations, 50*l.* On the Introduction and Acclimatisation of Foreign Fish, 25*l.* On the Propagation of Fresh-water Fish, excluding Salmonidæ, 25*l.* On the Propagation of the Salmonidæ, 25*l.* On Salmon Disease: its Cause and Prevention, 25*l.* On Oyster Culture, 25*l.* On the best Method which has been practically tested of cultivating Crustacea, 25*l.*

THANKS mainly to the exertions of Baron Miclucho Maclay, the Biological Station at Sydney has now been completed. It consists of a six-roomed cottage erected on the jutting point of land between Watson's Bay and Camp Cove. The building is of wood on a stone foundation with an iron roof. In the stone basement part of the space has been walled in, and when more funds are available other portions will be partitioned off as rooms for the carrying on of rough dissections and other operations which cannot well be carried on in the rooms above, and for the storage of bottles, spirits of wine, chemicals, dredges, nets, and other collecting gear. The rooms above are six in number, in three suites of two rooms each, so that biologists wishing to live close to their work may use one room as a bed-room, and the other as a laboratory. The laboratories are 15 feet by 12, with a lofty ceiling; the windows are large, with an easterly aspect, and large skylights permit of the entry of a certain amount of additional light from above. The partitions between the rooms are double—the interspace being filled with sawdust to deaden noises. A verandah 6 feet in depth runs round the whole building. Considerable additions require to be made to the appliances of the institution before it can be regarded as efficiently equipped for the purposes for which it is intended. Aquaria and other appliances are still wanting; and it is very desirable that a house should be erected for the accommodation of a paid caretaker, who should attend to the aquaria, dredge for specimens, and in other ways assist the biologists working in the stations. The Royal Society of New South Wales has granted the Biological Station the sum of 25*l.* from its funds, and it is expected that this grant will be repeated from year to year. The Royal Society of Victoria have also promised an annual sum, and the Australian Biological Association will also probably be in a position to grant an annual sum to the Sydney Station. Further subscriptions, however, are still required, and will be thankfully received by the treasurer. The station is open to biologists of the male sex, irrespective of nationality, on payment of a small weekly sum to meet the expenses of service, &c.

WE find some notes on the recent meeting of the American Association at Montreal, in the New York *Nation*. This year the well-known geologist, Principal Dawson, was the presiding officer. The attendance was large, especially from the United States. Among the men of note from across the ocean the most conspicuous are Dr. W. B. Carpenter, and the Rev. Dr. Haughton, of Trinity College, Dublin. Besides these may be mentioned Dr. Valdemar Kovaleski, Professor of Geology in Moscow, Dr. Kœnig, of Paris, the investigator in sound, and Mr. Fitzgerald of Dublin. The most liberal hospitalities of a prosperous city were extended to the guests from a distance. The retiring president, Prof. Brush, of New Haven, selected for his address a theme in his own department, and treated it like a master. His discourse was a good illustration of the tendency of scientific men to limit their work to a special line, and to avoid general observations upon the fields which they have not personally tilled. According to the *Nation*, there was nobody in the Congress, and not more than one person in all the land, so competent as he to review the history of American mineralogy, and to point out the requisites for the further prosecution of the science. A marked feature of American minerals, said Mr. Brush, is the grand scale upon which crystallisation has taken place—common mica in sheets a yard across, feldspar where a single cleavage plane measured ten feet, prisms of beryl four feet long—and so in general much larger crystals than those obtained from European localities. Another noteworthy fact is the occurrence, in abundance, of some of the rarer elements as constituents of the minerals found. For example, among the rare earths, glucina, zirconia, &c., lithium occurs in our lithia micas, and spodumene containing from 5 to 8 per cent. of lithia, occurs by the ton in at least one locality. Among rare metals which form metallic acids, columbium, the first metal new to science discovered in America, is found from Maine to Georgia. Many other examples were given, including the rare metal tellurium, which is found in Colorado in one locality, where masses of twenty-five pounds have been taken out. Yet only a small portion of the United States has been thoroughly explored, and we are far behind Europe in the variety of minerals obtained from our mines. If trained mineralogists would oftener go into the field, and if wealthy amateurs would aid in exploring American localities as freely as they engage in importing costly specimens from Europe, they would do much to foster science. In the afternoon of Wednesday the introductory addresses were given by heads of the nine sections into which of late the Association has been divided. The address in the Mathematical and Astronomical Section was read for its author, Prof. Harkness, of the Naval Observatory, on the Transits of Venus. It was an historical and, to a moderate extent, a critical review of what has been hitherto done in the observations of such transits, with particular reference to the results attained in 1874 and to those which are to be expected in 1882. Dr. H. C. Bolton, of Trinity College, gave a review of the recent work of the Chemical Section, and then took for his theme the history of chemical literature, especially in its early aspects. In physics the speaker was Prof. Mendenhall, of Columbus, O., who was formerly in Japan, and he made an address on the methods to be pursued in teaching physics in colleges. Prof. W. P. Trowbridge, of Columbia College, in the Section of Mechanics, made a strong plea for the promotion of experiments in mechanics, in close connection with theoretical studies. He dwelt upon the extraordinary demands now made by the public on engineers, and gave many illustrations of what experiment has done, and instances of what it may do in the future, to determine problems of profound importance. In the Biological Section, Dr. W. H. Dall, of Washington, gave an account of what has been accomplished in this country towards a knowledge of the biology of the molluscs. In the related Section of Histology and Microscopy Prof. Tuttle, of Columbus, O., questioned the propriety of a special microscopical section, and in the section last to be named, the Anthropological, a paper by Dr. Daniel Wilson, of Montreal, was read on some of the physical characteristics of certain native tribes in Canada. In the Physical Section the most remarkable paper was that of Prof. Rowland, describing the new gratings which he has made at the Johns Hopkins University for the study of the solar spectrum. He exhibited the results obtained by these gratings in photographs of the spectrum, which, it is stated, far surpass any that have hitherto been made. The generous and informal hospitality of Montreal received grateful recognition on all sides. Excursions had been arranged to Ottowa and Quebec, private houses were freely opened to guests; the Local Committee on one evening, Principal Dawson on another, and the Art Association on a third, offered evening entertainments. Public lectures were promised by Dr. Carpenter on Deep-Sea Soundings, and by Prof. A. Melville Bell on Visible Speech. The number of persons enrolled as in attendance was more than eight hundred.

IT is stated that the curiosities and other articles brought home in the screw survey ship *Alert*, Capt. Maclear, now lying at Sheerness, have been securely packed, and are to be forwarded to the Hydrographer's Department at the Admiralty, where they will be examined, and then probably distributed among the National Museums.

ON Saturday, September 9, the Members of the Essex Naturalists' Field Club had a field-meeting at Grays, for the second time this season, for the purpose of visiting the "dene-holes" in Hangman's Wood. As on the former occasion in June, arrangements had been made by Messrs. Brooks, Shoobred, and Co., of the Grays Chalk Quarries Company for the descent of the party into some of the holes, of which a very perfect one having six vaulted chambers was discovered, and was surveyed by Mr. T. V. Holmes, F.G.S. An ordinary meeting of the Club was held at the hotel in the evening, and some discussion as to the origin and age of these interesting prehistoric excavations took place. Mr. Henry Walker, Mr. Worthington Smith, and others, took part in the discussion, the president, Mr. R. Meldola, in conclusion, expressing his belief that much work would have to be done before the question could be in any way settled, and he suggested that the investigation should be taken up systematically by the Club.

THE Third Annual Cryptogamic Meeting of the Essex Field Club will be held on Saturday, September 23, in the Northern Section of Epping Forest, the head-quarters for the day being the "Crown Hotel," Loughton. At the evening meeting papers on cryptogamic botany will be read, and an exhibition of specimens will be held. Botanists wishing to attend should communicate with the Hon. Secretaries, Buckhurst Hill, Essex. This Club is rapidly developing into one of the most important local societies in the kingdom; its *Transactions*, of which part 6 is before us, have already attained formidable dimensions, and their contents are of solid value. In the new number we have papers on the "Origin and Distribution of British Flora," by Prof. Boulger; "On the Land and Freshwater Mollusca of Colchester District," by Mr. H. Laver; "The Galls of Essex," by Mr. E. A. Fitch; "The Mammalia of Essex," by Mr. H. Laver; A List of the Hymenomycetal Fungi of Epping Forest, by Dr. M. C. Cooke; besides the address by the president, Mr. Meldola, Journal of Proceedings, field meetings, &c.

WE have before us the *Proceedings* of several other local societies; in that of the Bristol Naturalists' we find papers on "The Age of the Wye," by Mr. C. Richardson; the Lepidoptera of the Bristol District, part v., by Mr. A. E. Hudd; the Fungi of the same district, by Mr. C. Bucknell, besides several papers on more general subjects. We are glad to meet with the *Transactions* of the Eastbourne Natural History Society in a more attractive and handy form than formerly; the number before us, for May, contains one or two papers on local subjects, though most of them are of a very general nature. The *Report and Transactions* of the Birmingham Natural History and Microscopical Society contains several good papers of a general character.

IN October Messrs. Longman and Co. will publish a Dictionary of Medicine, edited by Richard Quain, M.D., F.R.S. The editor has been engaged on this work for several years. He has, we are informed, received the assistance of a large number of the most eminent members of the medical profession, and others, who have contributed articles on subjects to which they have paid special attention. The work, it is stated, will furnish a complete record of the present state of medical science. It will be issued in one large volume containing nearly 1900 pp. medium octavo.

INTELLIGENCE received from the Austrian circumpolar observing party states that the *Pola* cast anchor in Marimus Bay, Jan Mayen, on July 13. In addition to the buildings brought in the ship, two more were erected from drift-wood, which was found in large quantities. There was little snow on the island, but much ice outside. The meteorological observations commenced on August 15 on the Beeren Mountain, at a height of 5000 feet. Two tablets stating the whereabouts of the expedition had been erected, one at Ekö, and the other in English Bay. The *Pola* left Jan Mayen on August 16.

SEVERAL shocks of earthquake have been felt at Panama recently; one on September 7 caused a great deal of damage, while on the 9th another shock seems to have done still more damage. Several towns in the interior seem also to have suffered, whilst the long-dormant volcanoes of Chiriqui are said to be active again.

THE example of the English Government has produced some effect on the French military aëronauts. Their captive balloons will be exhibited publicly for the first time in the great manœuvres of this year.

THE Academy of Aërostation will try on September 22 the system of aërial, panoramic photography, for which they have received a subvention from the City of Paris. This scientific experiment, which, it is expected, will bear interesting results, will take place on the occasion of the *fête* of the "Defence National," round the Lion of Belfort, at a very little distance from the Observatory.

IN the *Transactions* of the New Zealand Institute, vol. xv. (for 1881, published in 1882), Mr. W. M. Maskell, F.R.M.S., continues his valuable memoir on the *Coccidæ* of New Zealand, and describes interesting new forms. The descriptions appear to be clear, and the notes on economy full and serviceable. The figures are unfortunately rough, and in two instances where the males are delineated, are practically useless from this cause. This is unfortunate, because male *Cocci* are comparatively rare, and very much depends upon their careful delineation when discovered. We think no one would ever suspect the true position of the insect figured on Pl. xiv. Fig. 27, were it not for the surroundings.

WE have before us the *Sitzungsberichte und Abhandlungen der naturwissenschaftlichen Gesellschaft Isis in Dresden* for January–June, 1882. The publications of this old-established society seem to be scarcely so well-known in this country as they should be. The financial condition appears to be flourishing. There are few local societies in Germany that possess an invested capital of 250*l.* to 300*l.* We note, especially, the following papers contained in this part:—The Diamonds of the Royal Mineralogical Museum of Dresden, "crystallographische Untersucht," by A. Purgold; Results of observations at the meteorological station at Dresden, by Prof. S. A. Neubert; a paper on a fossil Pseudo-scorpion from the Carboniferous of Zwickau, by H. B. Geinitz; and another on fossil Cockroaches from the "Dyas" of Weissig, by Dr. Deichmüller, illustrated by a plate. There are also several botanical papers.

THE Swedish Government has decided, that from the beginning of next year no individual shall be employed on railways or on board ship in that country till his sight has previously been tested as to colour-blindness, by a method devised by Prof. Holmgren of Upsala.

WE have received a letter from a gentleman in Hong-kong, signing himself "Verax," referring to a note in our issue of June 1, on the subject of the projected Chinese telegraph line between Hong-kong and Canton, and the alleged refusal of the Colonial authorities to permit the landing of the cable across Victoria harbour on British territory. The facts as stated in our note he allows to be correct. But whatever the grounds—and "Verax" fails to show there are any substantial ones—for local opposition to the enterprise, we regard it as peculiarly unfortunate that any forward step of the Chinese should be retarded by the British authorities.

A MEMBER of the Russian Geographical Society, Mr. Poliakov, who with a few followers has been exploring the island of Saghalien, recently ceded by Japan to Russia, has just returned to St. Petersburg, having spent about a year in the island. He states that the greatest river, the Tymy, is navigable for vessels with sixteen feet draught for a distance of eight miles. This river is the only harbour on the island with the exception of Ruegda Bay on the north coast, but which is situated in a barren and unpopulated district. The flora and fauna were found to be the same as those of North Siberia. Judging from the antiquities and stone implements discovered, it is supposed that the island has been inhabited in prehistoric times, while other remains show that at one time large fisheries have been carried on here.

WE have on our table the following publications:—Ueber den Bau und das Wachtthums der Zellhäute, Dr. Ed. Strassburger (Fischer, Jena); Synthèse des Minéraux et des Roches, F. Fouque et Michel Levy (G. Masson); Elementary Botany, Henry Edmonds (Longman and Co.); Handbuch der Vergleichenden Anatomie, E. O. Schmidt (Fischer, Jena); Our Great Peril if war overtake us with our Fleet deficient in Number. Structure, and Armament, Admiral T. M. C. Symons, G.C.B. (W. Kent and Co.); The Economics of Fair Trade, W. R. Herkless (Wilson and McCormick); The Physiology and Pathology of the Blood, R. Norris, M.D. (Smith, Elder, and Co.); On Failure of Brain Power, Julius Althaus, M.D. (Longman and Co.); Benderloch: or Notes from the West Highlands, W. Anderson Smith (A. Gardner); Silurfossiler og Pressede Konglomerater I Bergensskifiene, Hans W. Reusch (Broggers, Kristiania); Meteorological Charts for the Ocean District adjacent to the Cape of Good Hope, Stationery Office; also Remarks explanatory of the foregoing; Catechism of Modern Elementary Chemistry, E. W. v. Volckxsom (Kegan Paul); Cameos from the Silverland, vol. ii., E. W. White (Van Voorst); Worms and Crustacea, Alpheus Hyatt (Green, Heath, and Co.); Micro-Fungi, Thomas Brittain (Heywood); Faith, the Life Root of Science, Philosophy, Ethics, and Religion, H. Griffith (Elliot Stock); Experimental Physiology, Richard Owen (Longmans); The Origin and Relations of the Carbon Minerals, Prof. Newberry; Tests of Incandescent Lamps for Fall of Resistance, &c., A. Jamieson; House Sanitation, G. H. Stanger, C.E. (C. John Steen, Wolverhampton); Induction, Willoughby Smith (Hayman Bros.); Hothouse Education, J. A. Digby (Stanford); Familiar Lessons on Food and Nutrition, Part I., T. Twining (Bogue); An Impromptu Ascent of Mont Blanc, W. H. Le Mesurier (Elliot Stock).

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus* ♂) from Java, presented by Mr. W. Mason; a Rhesus Monkey (*Macacus erythræus* ♀) from India, presented by Mrs. H. C. Dawson; a Crested Porcupine (*Hystrix cristata*), a —— Spider (*Mygale*, sp. inc.), a Scorpion (*Scorpio*, sp. inc.) from West Africa, presented by Mr. G. H. Garrett; six Spanish Blue Magpies (*Cyanopolius cooki*), three Pleurodele Newts (*Pleurodeles walti*) from Spain, presented by Lord Lilford, F.Z.S.; a Greater Vasa Parrakeet (*Coracopsis vasa*) from Madagascar, presented by Major-General Hill; two Common Barn Owls (*Strix flammea*), British, presented by Dr. Boyd, F.Z.S.; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mrs. Freeman; six Sand Lizards (*Lacerta agilis*), European, presented by Herr J. Sebliger; two Pennsylvanian Mud Terrapi (*Cinosternon pennyslyvanicum*), two Adorned Terrapins (*Clemmys ornata*) from North America, presented by Mr. A. Forrer; a Ring-tailed Coati (*Nasua rufa*) from South America, deposited; a Leopard (*Felis pardus* ♂) from Africa, a Small-eared Fox (*Canis microtis* ♂) from the Upper Amazons, a Marsh Ichneumon (*Herpestes paludosus*) from South Africa, two Water Chevrotains (*Hyomoschus aquaticus*), an Erxleben's Monkey (*Cercopithecus erxlebeni*) from West Africa, a Red-faced Saki (*Brachyurus rubicundus* ♀) from the Upper Amazons, a Weeper Capuchin

(*Cebus fatuellus*) from Guiana, a Red-billed Toucan (*Ramphastos erythoryhnchus*) from Cayenne, purchased; a Smooth Snake (*Coronella lævis*), European, received in exchange.

OUR ASTRONOMICAL COLUMN

DEFINITIVE COMET-ORBITS.—1. The fourth comet of 1874 (Coggia, April 17). Dr. Hepperger, of Vienna, has investigated the orbit of this comet from the whole extent of observation, founding his work upon 17 normals from 638 observed positions. He finds the orbit an ellipse with period of 13,708 years, and considers that his results exclude equally a parabola and any ellipse with a revolution shorter than 8000 years. The aphelion distance is 1144·9 (the earth's mean distance from the sun being taken as unity), at the descending node the radius-vector is 0·717, near the orbit of Venus, and at ascending node it is 11·734. Coggia's comet became visible to the naked eye at the beginning of June, and so continued until it was lost in these latitudes in the middle of July, when the tail had gradually increased to 23°.

2. Definitive elements have also been determined for the second comet of 1847, by M. Folke Engstrom of Lund. The comet was discovered by Colla at Parma, on May 7, and was last observed by the late Mr. Lassell at Starfield, Liverpool, on December 30, or over a period of nearly eight months. The orbit is chiefly remarkable for the large perihelion distance, 2·115, which has been exceeded in very few cases. The resulting elements are hyperbolic e = 1·0006549. So far as we know this is the only instance where the latest observations for position have been obtained with a reflector, the statement that has been more than once made that Halley's comet in 1836 was last observed by Sir John Herschel with his 20-feet reflector at Feldhausen, Cape Colony, being a mistake; the last observation was made by Lamont with the 11-inch refractor at Munich on May 17.

THE VARIABLE STAR ALGOL.—The following are the Greenwich times of minima of Algol, occurring before 15h., during the last quarter of the present year, taking Prof. Winnecke's ephemeris as authority:—

	h. m.		h. m.		h. m.
Oct. 14,	13 0	Nov. 9,	8 20	Dec. 16,	14 55
17,	9 49	26,	13 13	19,	11 44
20,	6 38	29,	10 2	22,	8 33
Nov. 3,	14 42	Dec. 2,	6 51	25,	5 22
6,	11 31				

THE MOTION OF 61 CYGNI.—The following formulæ appear to represent the observations of this remarkable system up to the present epoch within about their probable errors; P is the angle of position, D the distance:—

$$D \sin P = + 16''\!\cdot4657 + [8\cdot63013]\,(t - 1850\cdot0)$$
$$D \cos P = - \ 3\cdot6892 - [9\cdot27178]\,(t - 1850\cdot0).$$

Hence we find—

	Diff. R.A.	Diff. Decl.	
	″	″	
1753·8	+1·2	−1·7	Bradley.
1778	+1·9	−0·2	Ch. Mayer.
	Δ P (c − o).	Δ D.	
	°	″	
1781·85	+2·4	−0·04	Herschel I.
1812·30	−1·7	−0·69	Bessel.
1822·26	−0·1	+0·14	Struve and Herschel II.
1830·84	0·0	+0·01	Bessel.
1842·70	−0·3	−0·29	Dawes and Struve.
1856·37	−0·1	−0·29	Demb., Jacob, Secchi, 1854–1857.
1867·15	0·0	−0·16	Knott, Demb., Duner, 1866–67.
1877·47	0·0	0·00	Hall, Demb., Duner, 1875–79.
1881·45	0·0	−0·01	Jedrzejewicz.

And for comparison with measures about this epoch:—

	P.	D.
	°	″
1882·5	118·50	20·469
1883·5	119·08	20·476

THE COMET OF 1763.—The comet observed by Dunlop at Paramatta in 1833 has been referred to as affording an instance of near approach to the earth's orbit at both nodes; according to Dr. Hartwig's elements the distance at ascending node is 0·092, and at descending node 0·186. But a much more noticeable case is offered by the comet of 1763. In Burckhardt's ellipse we find the distance at ascending node 0·0315, and at descending node 0·0252, the time occupied in passing from node to node is 77·2 days.

THE EXCITABILITY OF PLANTS[1]

II.

THE complete knowledge we have gained from our study of the anther filaments of Centaurea of the mechanism of the excitable plant cell, can be applied to every other known example of irrito-contractility in the organs of plants, and particularly to that most remarkable of all such structures, the leaf of *Dionæa muscipula*. Although I described the structure of the leaf just eight years ago in this room, I will occupy a moment in repeating the description. The blade of the leaf is united on to the stalk by a little cylindrical joint. Here are two models, in one of which the leaf is represented in its closed state, in the other in which it is in its unexcited or open state. The leaf is everywhere contractile—that is, excitable by transmission, but not everywhere susceptible of direct excitation—or, in common language, sensitive. It is provided with special organs, of which we do not find the counterpart in any of the plants to which reference has been made, for the reception of external impressions—organs which, from their structure and position, can have no other function.

The action of the leaf, to which the plant owes its name, and by which it seizes its prey, is, in its general character, too well

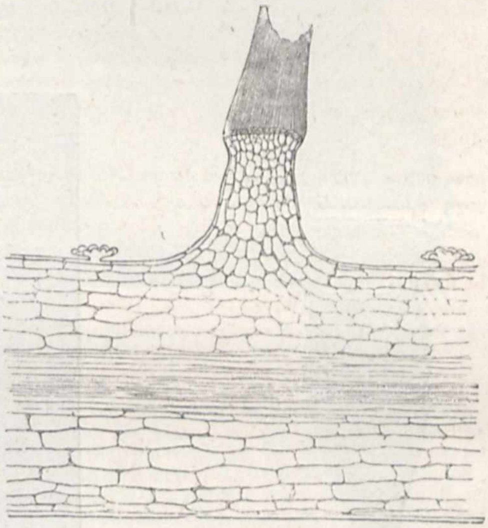


FIG. 6.—Transverse section of lobe of leaf of Dionæa comprising the root of a sensitive hair.

known to require description. In the shortest possible terms, it is the sudden change of the outer surface of each lobe of the leaf from convex to concave, and at the same time the crossing of the two series of marginal hairs, as the fingers cross when the hands are clasped. What I desire to show with respect to it is, that here also the agents are individual cells—that is, that the individual elements out of which the whole structure is built are the immediate agents in the production of the movement.

A cross-section of the leaf shows the following facts: If the section be made in the direction of the parallel fibro-vascular bundles which run out from the mid-rib nearly at right angles, and happen to include one of these bundles, it is seen that it consists of three parts, viz. the fibro-vascular bundle in the middle and equidistant from both borders; of the cylindrical cells of the parenchyma on either side, and of an external and internal epidermis. The external epidermis is smooth and glistening, and its cells possess thicker walls than those on the opposite surface.

[1] Lecture delivered at the Royal Institution June 9, 1882, by Prof. Burdon Sanderson, F.R.S. Continued from p. 356.

The most remarkable feature of the internal surface is, that it possesses the excitable hairs, three on each side, which in Dionæa are the starting-points of the excitatory process whenever it is stimulated by touch, as is normally the case when the leaf is visited by insects; for experiment shows that although the whole of the leaf can be excited either by pressure or by the passage of an induction current, the hairs exclusively are excited by touch. It is therefore of great interest to know their structure and their relation to the excitable cells of the parenchyma, with which they are in so remarkable a relation physiologically. In sections such as that which we will now project on the screen (Fig. 6), it is seen that each hair springs from a cushion which consists of minute nucleated cells inclosed by epidermis; and that if we follow this structure into the depth of the leaf, its central cells gradually become larger, until they are indistinguishable from those of the ordinary parenchyma of the leaf. By these cells it must be admitted that the endowment of excitability is possessed in a higher degree than by the ordinary cells of the parenchyma, so that for a moment one is tempted to assign to them functions corresponding to those of motor centres in animal structures (particularly in the heart). There is, however, no reason for attributing to them endowments which differ in kind from those we have already assigned to the excitable plant cell.

The fact that the excitable organs are exclusively on the

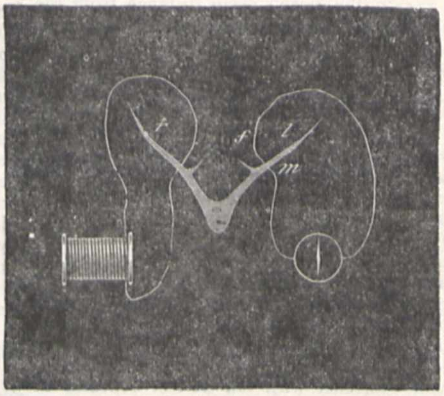


Fig. 8.

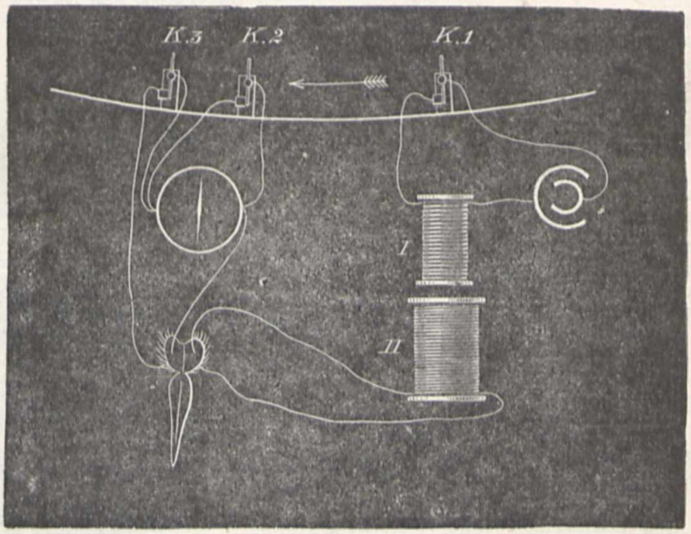


Fig. 9.

Fig. 7.

Fig. 7.—Dionæa leaf fixed so as to prevent its closing. (From a photograph). Fig. 8.—Diagram of ideal transverse section of lamina of leaf of Dionæa. The needle inclosed in a circle represents the electrometer which in the experiment described was substituted for the galvanometer. On the opposite side is shown the secondary coil of the inductorium. *m* is in connection with the capillary, *f* with the sulphuric acid of the electrometer. Fig. 9.—Diagram of the pendulum-rheotome. k_1, k_2, and k_3 are the keys referred to. I. and II. represent respectively the primary and secondary coils of the inductorium. The leaf galvanometer, battery, &c., will be easily recognised.

internal surface of the lobe, suggests that although the parenchyma of the inside has apparently the same structure, it has not the same function as that of the outside—that is, that although the cells of the outer layers are just like those of the inner, they are either not excitable at all, or are so in a much less degree. In this way only can we account for the bending inwards of the lobe. In the unexcited state both layers are equally turgid; as the effect of excitation the internal layers become limp, the external remaining tense and distended.

I will now endeavour to illustrate the motions of the leaf by projecting them on the screen. Here are several leaves which have been prepared by attaching one of the lobes to a cork support; the other is free, but a very small concave mirror has been attached to its external surface near the margin. The image of the light which falls on the mirror is reflected on the wall behind me. In this way the slightest movement of the lobe is displayed. By this contrivance I wish to show you two things—first that a very appreciable time elapses between the excitation and the mechanical effect; and secondly, that when the leaf is subjected to a series of very gentle excitations, the effects accumulate until the leaf closes. This we hope to show by bringing down a camel hair pencil several times in succession on a sensitive hair, doing it so deftly that at the first touch the lobe will scarcely move at all. At each successive touch it will bend more than at the preceding one, until you see the lever suddenly rise, indicating that the leaf has closed. The purpose which I have in view is to demonstrate the contrast between the motion of the leaf and muscular contraction. A muscle in contracting acts as one organ—at once. The motion of the leaf is the result of the action of many hundred independent cells, all of which may act together, but may not. In either case they take a great deal longer to think about it; for during a period after excitation, which amounts at ordinary summer temperature to about a second, the leaf remains absolutely motionless.

And now we have to inquire what happens during this period of delay. There are two things which we may assume as certain without further proof, namely, first that something happens; for when I see a certain movement followed after a time invariably by another, I am quite sure that the chain between cause and effect is a continuous one, although the links may be invisible; and secondly, that this invisible change has its seat in the protoplasm of each of the excitable cells.

We have already seen that in muscle this latent state of excitation is not withhout its concomitant sign—the excitatory electrical disturbance, and I have now to show you that this, which is the sole physical characteristic of the excitatory process in animal tissues, manifests itself with equal constancy and under the same conditions in plants.

It will be unnecessary for my present purpose to enter into any details as to the nature of the electrical change; it will be sufficient to demonstrate with respect to it, first, that when observed under normal physiological conditions, its phenomena are always conformable to certain easily defined characters; secondly, that it culminates before any mechanical effect of excitation is observable, and consequently occupies, for the most part, the period of latent excitation already referred to; and thirdly, that it is transmitted with extreme rapidity from one lobe of the leaf to the opposite. Of these three propositions, it will be convenient to begin with the second. On the left-hand screen is projected the mercurial column of the capillary electrometer of Lippmann. The instrument which we use this evening is one of great sensibility, given me by my friend Prof. Lovèn of Stockholm. The capillary electrometer possesses a property which for our purpose is invaluable—that of responding instantaneously to electrical changes of extremely short duration. We cannot better illustrate this than by connecting the wires of the telephone with its terminals. If I press in the telephone plate I produce an instantaneous difference between the terminals in one direction, and in the opposite when I remove the pressure. You see how beautifully the mercurial column responds.

We now proceed to connect the terminals with the opposite sides of a leaf, so that by means of the mirror we can observe the moments at which the leaf begins to close and the first movement of the mercurial column, both being projected on the same screen. We shall see that the mercurial column responds (so to speak) long before the mirror. The difference of time will be about a second.

We now take another leaf which, with the plants of which it forms part, is contained in this little stove, at a temperature of about 32° C. Our object being to subject the leaf to a succession of excitations, the effects of which would of course be to determine its closure, we prevent this by placing a little beam of dry wood across it, and fixing the ends of the beam with plaster of Paris to the marginal hairs of each lobe. At the same time,

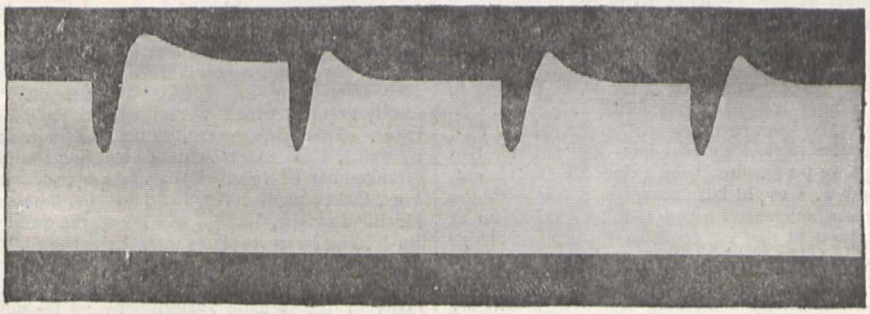


FIG. 10.—Copy of photograph of the excursions of the capillary electrometer as projected on a sensitive plate moving at the rate of ½ centimetre per second. The four "excitatory variations" shown were due to as many touches of a sensitive hair of the lobe opposite to that of which the opposite surfaces were connected with the terminals of the instrument.

wedges of plaster are introduced in the gap between the lobes at either end of the mid-rib. [The leaf so fixed was projected on the screen (Fig. 7).] This having been done, we can excite the leaf any number of times without its moving; and we know that we actually excite it by observing the same electrical effect which, in the first leaf experimented on, preceded the movement of the lobe.

And now I beg you to notice what the nature of the experiment is. The diagram (Fig. 8) shows the position of the electrodes by which the opposite surfaces are connected with the terminals of the electrometer. You will notice that they are applied to opposite points of the internal and external surfaces of the right lobe, and that the left lobe is excited. The experiment consists in this. By the electrodes near *r*, an induction shock passes through the right lobe. Apparently at the same moment the electrometer, which is in relation with the opposite lobe, responds. I say apparently, because in reality we know that the response does not begin until about 3-100th of a second later. We prove this by a mode of experimentation which is of too delicate a nature to be repeated here. I will explain the mode of action of the instrument used by a diagram (Fig. 9) which represents a pendulum in the act of swinging from left to right. As it does so, it opens in succession three keys, of which the first is interpolated in the primary circuit of the induction apparatus which serves to excite the leaf; the second breaks a derivation wire which short-circuits the electrodes, so that, so long as it is closed, no current passes to the galvanometer, which in this experiment takes the place of the electrometer, while the third breaks the galvanometric circuit. Consequently the opposite surfaces of the leaf are in communication with the galvanometer only between the opening of the second and third keys. These three keys can be placed at any desired distance from one another. If they are so placed that the galvanometer circuit is closed 1-100th of a second after excitation, and opened 3-100th of a second, and it is found that there is no effect, it is certain that the electrical disturbance does not begin at the part of the leaf which is interpolated between the galvanometer electrodes until at least 3-100th of a second after the excitation. If, on extending the period of closure to 4-100th of a second, the effect becomes observable, you are certain that the disturbance begins between three and four hundredths of a second after excitation.

By this method we have learnt, first, that even when the seat of excitation is as near as possible to the led-off spot, there is a measurable delay, and secondly, that its duration varies with the distance which the excitation effect has to travel so as to indicate that, in a warm stove, the rate of transmission is something like 200 millimeters per second. It is, consequently, comparable with the rate of transmission of the excitatory electrical disturbance in the heart of the frog.

And now I come to my last point, namely, that the electrical change has always the same character under the same conditions. You have already seen that when the method used is that which I have indicated, the electrical effect consists of two phases, in the first of which the external surface of the leaf becomes negative to the internal. I will now exhibit this in another way. Many present have probably seen in a recent number of NATURE reproductions of photographs recently taken by M. Marey, of the phases of the flight of birds. If the movement of a bird's wing can be photographed you will easily imagine that we can also obtain light-pictures of such a movement as that of the electrometer column. You have only to imagine a sensitive plate moving at a uniformly rapid rate taking the place of the screen, and you have as the result the photograph (Fig. 10) which I show. Here are the electrical effects of several successive excitations recorded by light with unerring exactitude. In each, the diphasic character is distinct, and you see that the first or negative phase lasts less than a second, but that the positive, of which the extent is much less, is so prolonged that before it has had time to subside it is cut off by another excitation.

It would have been gratifying to me, had it been possible, to exhibit to you other interesting facts relating to the excitatory process in our leaf. It has, I trust, been made clear to you that the *mechanism* of plant motion is entirely different from that of animal motion. But obvious and well marked as this difference is, it is nevertheless not essential, for it depends not on difference of quality between the fundamental chemical processes of plant and animal protoplasm, but merely on difference of rate or intensity. Both in the plant and in the animal, work springs out of the chemical transformation of material, but in the plant the process is relatively so slow that it must necessarily store up energy, not in the form of chemical compounds capable of producing work by their disintegration, but in the mechanical tension of elastic membranes. The plant cell uses its material *continually* in tightening springs which it has the power of letting off at any required moment by virtue of that wonderful property of excitability which we have been studying this evening. Animal contractile protoplasm, and particularly that of muscle, does work only when required, and in doing so, uses its material directly. That this difference, great as it is, is not essential, we may learn further from the consideration that in those slow motions of the growing parts of plants which form the subject of Mr. Darwin's book, "On the Movements of Plants," there is no such storage of energy in tension of elastic membrane, there being plenty of time for the immediate transformation of chemical into mechanical work.

I have now concluded all that I have to say about the way in which plants and animals respond to external influences. In this evening's lecture you have seen exemplified the general fact, applicable alike to the physiology of plant and animal, that whatever knowledge we possess has been gained by experiment. In speaking of Mimosa, I might have entertained you with the ingenious conjectures which were formed as to its mechanism at a time when it was thought that we could arrive at knowledge by reasoning backwards—that is, by inferring from the structure of living mechanism what its function is likely to be. In certain branches of physiology something has been learnt by this plan, but as regards our present investigation, almost nothing, nor indeed could anything have been learnt. Everywhere we find that nature's means are adapted to her ends, and the more perfectly, the better we know them. But, with rare exceptions, knowledge is got only by actually seeing her at work, for which purpose, if, as constantly happens, she uses concealment, we must tear off the veil, as you have seen this evening, by force. Have we the right to assume this aggressive attitude? Ought we not rather to maintain one of reverent contemplation—waiting till the truth comes to us?

I will not attempt to answer this question, for no thoughtful person ever asked it in earnest. Another question lies behind it, which is a deeper and a much older one. Is it worth while? Is the knowledge we seek worth having when we have got it? Notwithstanding that so recently even those who are least conversant with our work have been compelled to acknowledge the beauty and completeness of a life devoted to biological studies, still the question is pressed upon us every hour—How can you think of spending days in striving to unravel the mechanism of a leaf, when you know all the time that if there were no such thing as Dionæa, the world would not be less virtuous or less happy? That is a question which I willingly leave to those who put it. From their point of view it does not admit of an answer; from mine it does not require one. They must go on seeking for and finding virtue and happiness after their fashion; we must go on after ours, striving by patient continuance in earnest work, to learn year by year some new truth of nature, or to understand some old one better. In so doing, we believe that we also have our reward.

THE BRITISH ASSOCIATION

REPORTS

Third Report of the Committee appointed for the Purpose of Reporting on Fossil Polyzoa (Jurassic Species—British Area only). Drawn up by Mr. Vine (Secretary).—A partial examination of the Jurassic Polyzoa was made by Goldfuss (*Petrifacta Germaniæ*, 1826-33), but the author is not aware whether he had any English examples of the types described and figured by him. With the exception of the *Aulopora*, all the types are foreign, and he does not find any reference to British species in his text. In the "Geological Manual" of De la Beche, published in 1832, a list of species is given, but only two are named as found within the British area—*Cellipora orbiculata*, Goldfuss (=*Berenicea*, Lamouroux), and *Millepora straminea*, Phill. In the "Geology of York," ed. 1835, Phillips gave three species only—*M. straminea*, *Cellarea Smithii* (*Hippothoa* (?), Morris's Catalogue), Scarborough, and an undescribed *Retepora* (?). When, in 1843, Prof. Morris published his "Catalogue of British Fossils," there was a large increase of species, but many of these had not been thoroughly worked. In 1854, Jules Haime examined critically the whole of the Jurassic Polyzoa then known, and many English naturalists furnished him with material from their own cabinets so as to enable him to correlate British and foreign types. Lamouroux, Defranc, Milne Edwards, Michelin, Blainville, and D'Orbigny have published descriptions of Jurassic species, and a list of these, so far as possible, will be given at the end of this report. Prof. D. Braun, by the publication of his paper on species found in the neighbourhood of Metz, added materially to our knowledge of French Jurassic types, and later foreign authors, Dumortier Waagen and others, have increased the number of described species. Since the publication of Haime's work, much valuable material has been accumulating in the cabinets of collectors, and Mr. Vine willingly draw up a monograph if desired to do so. In the meantime he offers, in the following report, a rather compact analysis of genera and species known by name or otherwise to the palæontologist.

Classification.—Haime's arrangements of the Jurassic Polyzoa is very simple; all his species, excepting two, are placed in one family, the *Tubuliporidæ*. In the "Crag Polyzoa," 1859, Prof. Busk gave a synopsis of the "Cyclostomata," arranged in eight family groups, which were made to include several Mesozoic types. This arrangement, with a slight alteration, was followed by Smitt, Busk to some extent accepting the modification for the arrangement of recent Cyclostomata in his later work ("Brit. Mus. Cat.," pt. iii., 1875). The Rev. Thomas Hincks ("Brit. Marine Polyzoa," 1880) disallows the family arrangement of Busk in so far as it relates to British species. The *Tubuliporidæ*, Hincks, include, in part, three of the families of Busk. In this report Mr. Vine follows Hincks as far as he is able to do so, as many of the Jurassic species may be included in the family *Tubuliporidæ* as now described. It will, however, in the present state of our knowledge at least, be impossible to arrange the species stratigraphically, as many, having the same type of cell, range from the Lias upwards. As far as the author is able to do so, he gives the range of the species, beginning, of course, with the lowest strata.

CLASS POLYZOA. Sub-order *Cyclostomata*, Busk. Fam. I. *Crisidæ*, Busk.—No fossils belonging to this family are at present known to have existed in the Jurassic epoch.

FAM. II. 1880. *Tubuliporidæ*, Hincks.—*Zoarium* entirely adherent, or more or less free and erect, multiform, often linear, or flabellate, or lobate, sometimes cylindrical. *Zoœcia* tubular, disposed in contiguous series or in single lines. *Oœcium*, an inflation of the surface of the zoarium at certain points, or a modified cell" (vol. i. p. 424).

1825. *Stomatopora*, Bronn. 1821. *Alecto*, Lamx.; 1826, *Aulopora* (pars), Goldf.—The Reporter has already done partial justice to the unserial *Stomatopora*, found in the Palæozoic rocks of this and other countries. He has again studied the species described by James Hall, Prof. Nicholson, and himself, and he cannot, at present, detect any generic character in the species that may be used by the systematic palæontologist to separate the Palæozoic from the Mesozoic types. He must, therefore, regard the *Stomatoporæ* of the two epochs as one, though the sequence is broken in the Palæozoic—no species having as yet, he believes, been recorded from the Carboniferous series of this or any other country.

In our modern classification (Hincks) we have a sub-genus, *Proboscina*, which links together the genera *Stomatopora* and *Tubulipora*. Haime's second genus is also called *Proboscina*, but there seems to me to be a great difference between the recent and fossil species. The type of the recent sub-genus *Stomatopora incrassata*, Smitt, is a very peculiar species as regards the cells, and he knows of no Jurassic type that can compare with it.

Terebellaria. Lamouroux.—"A fossil, dendroid polypary, composed of cylindrical scattered branches, spirally twisted from left to right or from right to left indifferently; pores prominent, almost tubular, numerous, disposed quincuncially, and more or less inclined according to their porition with the spires." Lamouroux says the genus should be placed after the *Millepores* and before the *Spiroporæ*, remarking "that the *Spiroporæ* have the cells or the pores projecting as in *Terebellaria*, but that this character is observable only in well-preserved specimens. When the prominent part of the spire has been worn by attrition, it looks like a narrow riband wound round the branch." The fossils which ordinarily pass for species of *Terebellaria* in the cabinets of collectors are a very curious group that may be more closely studied. Mr. Vine's studies are made from specimens from the Cornbrash, and Bradford Clay of Bradford and Stanton, Wilts, and it is from this locality that the School of Mines specimens were obtained. To properly master the details of colonial growth, it will be necessary to isolate a single colony. The one furnished by Haime as a specimen of a young colony on stone shows a tapering proximal point, gradually widening by the addition of cells, till a certain fan-like shape is arrived at. A similar growth to this is found in young colonies of *Diastopora*. If superficially examined, it will be seen that the cells are peculiarly arranged, beautifully punctured, with an orifice sometimes circular, at other times semi circular, and sometimes the cell characters of portions of the colony bear a resemblance to *Bidiastopora ramosissima* of D'Orbigny. A complete and critical examination of the type will show that any fragment of stone or shell is sufficient to form the nucleus of a colony. It begins with a primary cell and then enlarges in a spiral direction, but to what extent the riband-like growth would be carried without a check I am unable to say. In another direction a similar colony will be developed, the distal cells of which will ultimately meet and coalesce, both colonies striking out in fresh directions till met by another check, the growth not always being in an upward direction. The dendroid character of species is perfectly accidental.

Genus *Diastopora*, Lamx. Sy. with *Berenicea* (pars), Lamx. —Mr. Vine accepts this genus, in its wider sense, as defined by Hincks; yet he hardly thinks that it will be possible to include the whole of the foliaceous forms of the Jurassic period in one group. In this report he adheres to the arrangement of Busk, as he has done in his two papers on the Diastoporidæ, keeping the foliaceous types for distinct study. At the same time he is willing to admit that in getting rid of one difficulty in our grouping we open the door to admit others. Haime admits both the encrusting and foliaceous types, accepting the genus *Berenicea* for the encrusting, and *Diastopora* for simple-foliaceous and retiform species. Prof. Braun, in his Jurassic studies, separates the species *Diastopora foliacea* from the group, and establishes another, which he calls *Elea*, claiming for his type certain peculiarities which have been entirely overlooked by authors. It is very certain that the more closely we examine Jurassic Polyzoa and compare them with modern species of the genus *Diastopora*, the more divergent the types appear; and although we would rather accept a simple than an elaborate classification, still there are limits beyond which it is not wise to go.

BISERIAL DIASTOPORA, Milne Ed. *Mesenteripora*, Blainville; *Bidiastapora*, D'Orb; *Ditaxia*, Hagenow.—It is well that the encrusting and biserial *Diastopora* should be separated, but not widely so. In the choice of the above names he has selected the simplest—*Diastopores biserialares* of Milne Edwards—because it has the precedence of the *Bidiastopora* of D'Orb. Busk—in the "Crag Polyzoa" and in the "Brit. Mus. Cat." pt. iii—has chosen Blainville's name for this division of the group. Mr. Vine's chief objection to Blainville's term for the biserial species may be found in the diagnosis as given by Busk: "Cells in two layers, parted by a calcareous septum." In all the specimens figured in "Crag Polyzoa" (Plates xvii. Fig. 2; xviii. Fig. 4; and pl. xx. Fig. 2, pp. 109, 110) of *Mesenteripora meandrina* the transverse sections of the foliaceous zoarium are shown to have this septum very distinct. In many of Haime's figures where cross sections are given, the septa are also shown to be present. It seems to him, judging from the foliaceous specimens in my own cabinet, that this "calcareous septum" is only an apparent, and not a real character. If sections are made in a line with the cells, the only axis visible is that made by sections of the cell walls. In a cross section of the foliations there is an apparent septal division, but the more closely this is examined the less real will it be. The septal divisions of *D. scobinula*, *D. Terquemi*, and *D. cervicornis*, as given by Haime, show one, two, and three sections of cells on either side of the septal line; and specimens of Inferior Oolite species found in the neighbourhood of Cheltenham are in many respects of a similar character. As Mr. Vine has been able to examine only a very limited number of species, he would be glad to have more detailed information if students of our Oolitic Polyzoa will address their attention to this point. Meanwhile, by selecting the divisional name of Milne Edwards, he does not commit himself to any generic name dependent upon a questionable structural character.

1822. *Intricaria*, Defranc. 1830. *Cricopora*, Blainville. 1840. *Meliceritites*, Roemer. 1850. *Entalophora*, D'Orbigny. 1853. *Cricopora*, *Spiropora*, *Tubigera*, *Meliceritites*, *Laterotubigera*, *Entalophora*, D'Orb. Palæontology.—He has already vindicated by use and preference the retention of this genus for species of Palæozoic Polyzoa. He still retains the name for species of the genus very common in the Mesozoic rocks. He has also given the synonyms with their dates of genera intended to supersede Lamouroux's original term. It may be as well to define and limit the genus as applicable for the reception of Palæozoic, Mesozoic, and Cainozoic species. He is not aware that any recent species of Polyzoa can be included in the group.

FAM. III. HORNERIDÆ, Hincks.—This family contains only one genus, *Hornera*. There is no representative of the family, in Brit. Jurassic Rocks at least, and he is not aware of any recorded species of the genus in foreign Oolites. As the Rev. Thomas Hincks says that "the genus HORNERA is connected with TUBULIPORIDÆ, through *Idmonea*," to which it bears in many points a very close resemblance, in all probability early types of the genus, as defined by him, may yet be found in either the Jurassic or Cretaceous rocks. The *Siphodictyum*, of Lonsdale, is given as one of the synonyms of Hornera.

FAM. IV. LICHENOPORIDÆ.—This is the last family given by Hincks in which Jurassic Polyzoa can be placed. The genus *Lichenopora* of Defranc has also a number of synonyms, but as species of the genus are rare in the Oolites, we find only one recorded. Haime says the genus has not been represented until now, other than by Tertiary or Cretaceous fossils. In *Lichenopora Phillipsii*, derived from the Great Oolite of Hampton Cliff, the *zoarium* is disciform, very slightly elevated, and adherent only by the middle of its inferior face. The upper surface resembles a fungus, with unequally developed rays formed of a series of long zoœcia, ordinarily doubled. The peristomes are polygonal, regular, and closely connected.

1835. *Neuropora*, Bronn.; *Chrysaora*, Lamx; *Filicaria*, D'Orb.—Species belonging to this genus are present in our British Oolites, in the Bradford Clay, and Cornbrash, but he has not been able to secure specimens to operate upon so as to study the internal characters. Dumortier describes several species from the Middle Lias, Haime describes three from the Great Oolite of Ranville and Hampton Cliffs, and Prof. Brann says that it extends from the Lower Lias onward into the White Jura and also into the Great Oolite of Ranville. It is also found about Metz. Through the kindness of Prof. Roemer of Breslau Mr. Vine had supplied to him the species of *Ceripora*, Goldfuss, which are referable to this genus, but the types differ in many particulars from our own species.

1834. *Heteropora*, Blainville.—We have now left one group of Oolitic Fossils which within the last few years have been more closely studied than any of the others, because of their supposed relationship with the Palæozoic *Monticulipora*. In his "Pertifactions of Germany," Goldfuss placed in the genus *Ceriopora* three species, which he describes and figures as containing large and small openings on the surface of the branches. These were *Ceriopora anomalopora*, *C. cryptopora*, and *C. dichotoma*, all of which were from the Mastricht beds of Astrupp or Nantes. In 1834 M. de Blainville separated these from the *Ceriopora* of Goldfuss, and established another one for their reception which he called *Heteropora*, assigning as essential structures the two sorts of openings, but giving very few details respecting the genus. After this Milne Edwards added to them *Millepora dumitosa* and *corigera*, Lamouroux. In his "Miocene Fossils of North America," Mr. Lonsdale complained of the inadequate description of Blainville as not having in it sufficient details "to enable an opinion to be formed of its complete characters, or of the nature of the minor openings." This error was to some extent rectified by Lonsdale, and we owe to him the merit of being the first author who clearly indicated upon sufficient grounds the real zoological position of the genus.

Report of the Committee on Electrical Standards.—Mr. Taylor had been engaged during the past year in determining the effect of the annealing of wires on the temperature co-efficient of their resistance. The experiments were not yet concluded, but so far they had shown that the effect of annealing was enormous, in some cases altering the temperature co-efficient by as much as 50 per cent. The Committee hoped that Lord Rayleigh would arrange a system for testing resistances at the Cavendish Laboratory. In connection with this report Lord Rayleigh made some remarks *On making Standard Resistance Coils equal to Multiples of an Original Unit Coil.* The usual method is to make a copy of the unit coil; by combining these, a coil of two units can be made, then of four, five, and so on. By this means the errors would accumulate. The method he proposed was simpler than this. Three coils each of three units resistance, placed in multiple arc, are equivalent to one unit, whilst in series the resistance amounts to nine units. This, with the addition of the original unit, makes a resistance of ten units. The observations should be made quickly after one another, and he explained an arrangement of mercury cups by which this was effected with rapidity.

Report of the Committee on Meteoric Dust, by Prof. Schuster.—The report referred to the work of M. Tissandier, who has found magnetic particles of iron in the dust gradually settling down in dry weather, or precipitated by rain or snow. These particles are of various shapes, but the most remarkable form is a spherical one, which conveys the obvious information that the particles at one time must have been in a state of fusion. These have been found in the snows on the slopes of Mont Blanc, at a height of nearly 9000 feet, in the sediment of rain collected at the observatory of Sainte Marie du Mont, and in the dust collected at different elevated positions. For an explanation of these magnetic spherules we are reduced to three alternatives. The particles may be of volcanic origin, they may have been fused in our terrestrial fires, or they may be meteoric. All the volcanic dust which the author has had at his disposal was carefully examined under the microscope, but its appearance was found to be altogether different from the supposed meteoric dust. Such also seems to be the conclusion arrived at by Tissandier. No iron spherules to the author's knowledge have been found in volcanic dust. The smoke issuing from the chimneys of our manufacturing towns contains iron particles similar in appearance to those to which Tissandier ascribes a meteoric origin. That some of these particles are found very far from any terrestrial sources which can produce them, would not perhaps tell conclusively against their terrestrial origin, but chemical analysis seems to settle the point. The iron particles issuing from our chimneys contain neither nickel nor cobalt, while these metals were found by Tissandier to exist in the microscopic magnetic particles found in rain-water collected at the observatory of Sainte Marie du Mont. We are, therefore, driven to ascribe a cosmic origin of these particles. During the last year the author has examined microscopically small iron particles from the sand near the great pyramids, from the desert of Rajpootana, and from the Nile mud near the village of Sohag. The sand from the pyramids contains an appreciable quantity of magnetic particles. The great part of these particles are angular, and doubtless are due to the *débris* of magnetic rocks; but here and there spheres are found exactly like those described by Tissandier, and about the same diameter, that is 0·2 to 0·1 mm. The Rajpootana sands are not yet completely investigated, but as yet there has been no appearance of metallic iron. The author then passes on to consider the *débris* left behind in our atmosphere by the passage through it of shooting-stars. Tissandier has examined the dust found on meteors, and has found that it resembles in appearance the magnetic particles found in other places. The question arises, how is it that the red hot sparks from the meteors do not get oxidised, and the author pointed out that at high elevations the proprotion of oxygen in the atmosphere is very small, at a height of 100 kilometres being about 4 per cent. of the whole, supposing the temperature the same throughout the atmosphere. He also drew attention to the fact that a line in the spectrum of the aurora has not been recognised as belonging to any known substance, and from his experience in observing the spectra of oxygen and nitrogen under very various conditions, he felt convinced that it was not due to oxygen or nitrogen, but to some unknown gas of very small density. He pointed out that at a great height the density of this would only very slightly be diminished, and although of extremely small density, would nevertheless form by far the largest part of the atmosphere there. Consequently the meteoric sparks would only meet a very small proportion of oxygen. He mentioned that the spherules might be easily produced artificially by moving a file over a copper wire conveying a current of electricity. Collecting the sparks which fly off, these were found to contain a large proportion of spherules similar to those referred to meteoric origin, together with angular specimens such as had been found in some of the sands.

In *the Report of the Committee on Wind Pressure* it was stated that the maximum pressure on small plane surfaces had been ascertained to exceed 80 lbs. and even 90 lbs. per square foot. The pressure over any large area was still a matter of considerable uncertainty, but it was possible that the maximum pressure of 56 lbs. allowed by the Board of Trade might take effect over the whole of very exposed structures. The cases of wind and water pressure were somewhat analogous, at any rate with regard to the proper method of determining the relative exposure in various positions. In the latter case this might be done by a comparison of the readings of anenometers differently located.—Prof. W. C. Unwin remarked that some form of pressure guage of considerable delicacy was needed which could be applied to all parts of a roof. Mr. Barlow said that the Board of Trade rule was capable of being amended, and this no doubt would be done as soon as further knowledge was forthcoming; in the proposed Forth Bridge 3000 tons of steel would be employed for resisting wind pressure.

In the *Report of the Committee on Screw Guages* it was stated that there is at present no universally recognised form of screw-thread and no specified number of threads to the inch. For telegraphic and electrical apparatus some coherent and uniform system is much wanted. The report gave an account of the efforts made in Switzerland towards this end, and explained the screw guage finally adopted by that country. Much credit is due to Sir Joseph Whitworth for his important work in connection with the improvement of the system in England. The Committee asked to be re-appointed.

SECTION A—MATHEMATICAL AND PHYSICAL

On a Similarity between Magnetical and Meteorological Weather, by Balfour Stewart, M.A., L.L.D., F.R.S., Professor of Physics at the Owens College, Manchester.—It has been hitherto supposed that there is no traceable likeness between the magnetical and meteorological changes of the globe. The former have been imagined to be of a cosmical nature affecting all parts of the earth at the same moment of time, while the latter are well known to be of a local and progressive nature. As a matter of fact, all attempts to trace a likeness between simultaneous magnetical and meteorological phenomena have been without success.

There is however one class of magnetical phenomena that are of a progressive nature. I allude to the diurnal variations of the magnetic elements caused by the sun. Of these the solar-diurnal variation of the magnetic declination—that is to say the variation of the position of a freely suspended magnetic needle is that which has been most observed and best understood.

It has been noticed that the diurnal progress of this variation is not unlike that of atmospheric temperature; the hourly turning points in both being pretty nearly the same. Both phenomena too are regulated by the local time at the place of observation, and hence are of a progressive nature, travelling with the sun in his apparent course from east to west. Both phenomena too are subject to a well-marked annual fluctuation, the diurnal temperature range, for instance, or the difference between the indications of the maximum and the minimum thermometers being greater in summer than in winter; and in like manner the diurnal declination range or the difference between the east and the west positions of a suspended magnet being greater in summer than in winter. Finally both phenomena appear to be subject to the influence of something which may be called *weather*. Sometimes we have very hot days and cold dry nights in which the diurnal temperature range is very great, succeeded by close rainy weather in which the diurnal temperature oscillation is very small. In like manner we have sometimes a very large and at other times a comparatively small diurnal oscillation of the magnetic needle, so that it too is affected by the influence of magnetic weather. The question which I now wish to put is the following: Is there any connexion between these two weathers? between the temperature-range weather, and between declination-range weather, both defined as above?

Now there is I think preliminary evidence to show that both kinds of weather are due very greatly, if not altogether, to changes in the sun, a large declination-range, and a large temperature-range denoting an increase of solar power. There is also evidence that temperature-range weather once produced travels from west to east, taking probably on an average eight or nine days to cross the Atlantic.

There is also, I think, preliminary evidence that declination-range weather travels likewise from west to east, but quicker than temperature range weather, taking about two days to cross the Atlantic.

Now if this be true it might be expected that the declination-range weather of to-day should be found similar to the temperature-range weather six or seven days afterwards, so that by a study of the declination-range weather of to-day, we should be able with a certain measure of success to predict the temperature-range weather six or seven days afterwards.

I have here given the train of thought which led to this investigation, but, I ought to say that the results obtained do not depend upon the exact truth of every step of this train of reasoning.

This is in reality a matter of fact investigation undertaken with the view of ascertaining whether or not there is any recognisable connexion between these two weathers in Great Britain. The result obtained I may add was reported to the Solar Physics Committee, and by them communicated to the Royal Society.

In order to avoid as much as possible the influence of locality, I obtained through the kindness of the Meteorological Council the diurnal temperature ranges at Stonyhurst, Kew, and Falmouth for the years 1871 and 1872. I obtained likewise through the kindness of the Kew Committee, the diurnal ranges of magnetic declination at the Kew Observatory for the same two years, excluding disturbed observations. The temperature ranges discussed are therefore the means of those at the three observatories above mentioned, and still further to tone down or equalize individual fluctuations, the daily numbers exhibited are each the sum of four daily ranges the two before and the two after. Finally the object being to represent fluctuations of range rather than their absolute values, a daily series representing the mean of twenty-five daily numbers has been obtained. Each daily number is thus compared with the mean of twenty-five daily numbers both columns being symmetrically placed with regard to time and the differences whether positive or negative between the two columns is taken to represent temperature-range fluctuations.

A precisely similar course has been taken with respect to the Kew declination ranges.

By this means two years of daily numbers, sometimes positive and sometimes negative, representing temperature range weather, and two years of daily numbers sometimes positive and sometimes negative representing declination range weather, have been obtained. The next object is to compare the two series with one another.

Now when two series of waves representing elevations and depressions come together it is well known that we shall have the greatest result when the crests of the one series coincide with the crests of the other, and the smallest result, perhaps even none at all, when the crests of the one series coincide with the hollows of the other. This indeed is the well known explanation of musical beats.

Now if there be any marked likeness between the two weathers and if it be true that declination-range weather precedes temperature weather by six or seven days, the algebraic sum of the two sets of fluctuations representing these weathers will be greatest when the declination is pushed forward in point of time so that the declination fluctuations of to-day shall be summed up with the temperature fluctuation six or seven days after.

For suppose that the declination fluctuation of to-day is represented by a very large positive number; if the above theory be true, the temperature fluctuation six or seven days afterwards will be represented by a large positive number also, so that we shall have the addition of two large positive numbers, whereas, if we add the declination weather of to-day to the temperature weather of to-day it may chance that we are really adding a large positive to a large negative quantity in which case the result will be very small. It may also happen that this amount of precedence of declination-weather is greater at one season of the year than at another.

We have therefore to pursue a plan somewhat of the following nature. Take a month's temperature-weather say for the month of August and add to it a month's declination-weather, extending say from July 21st to August 21st, let the sum be 262. Here the declination month has been pushed forward 11 days. Next push it forward 12 days and let the sum be 273, then 13 days and let the sum be 276, next 14 days and let the sum be 270. It thus appears that the greatest sum is got by pushing the declination forward 13 days, and we may therefore presume that at this season of the year 13 days denotes the precedence of the declination weather.

On this principle the following table has been constructed.

Table showing by how many days the declination-range fluctuation precedes the corresponding temperature-range fluctuation.

Corresponding to middle of month.	Precedence of Declination. First year.	Second year.	Mean.
January	—	8	8
February	6	4	5
March	6	5	5·5
April	5	5	5
May	9	9	9
June	9	9	9
July	12	11	11·5
August	13	13	13
September	9	10	9·5
October	7	5	6
November	10	7	8·5
December	12	—	12

It thus appears from each year that the precedence of declination is smallest about the equinoxes, and greatest about the solstices, and it seems probable that were a considerable number of years so treated, more exact values would be obtained. Having thus determined the amount of precedence of the declination from month to month, the next point is to ascertain to what extent the two fluctuations when brought together in a manner regulated by this precedence show any distinct resemblance to each other. This has been done in a graphical representation which accompanies the report above-mentioned and I think I may say that there is a considerable likeness between the two curves, the one exhibiting temperature-range weather and the other declination-range weather so pushed forward.

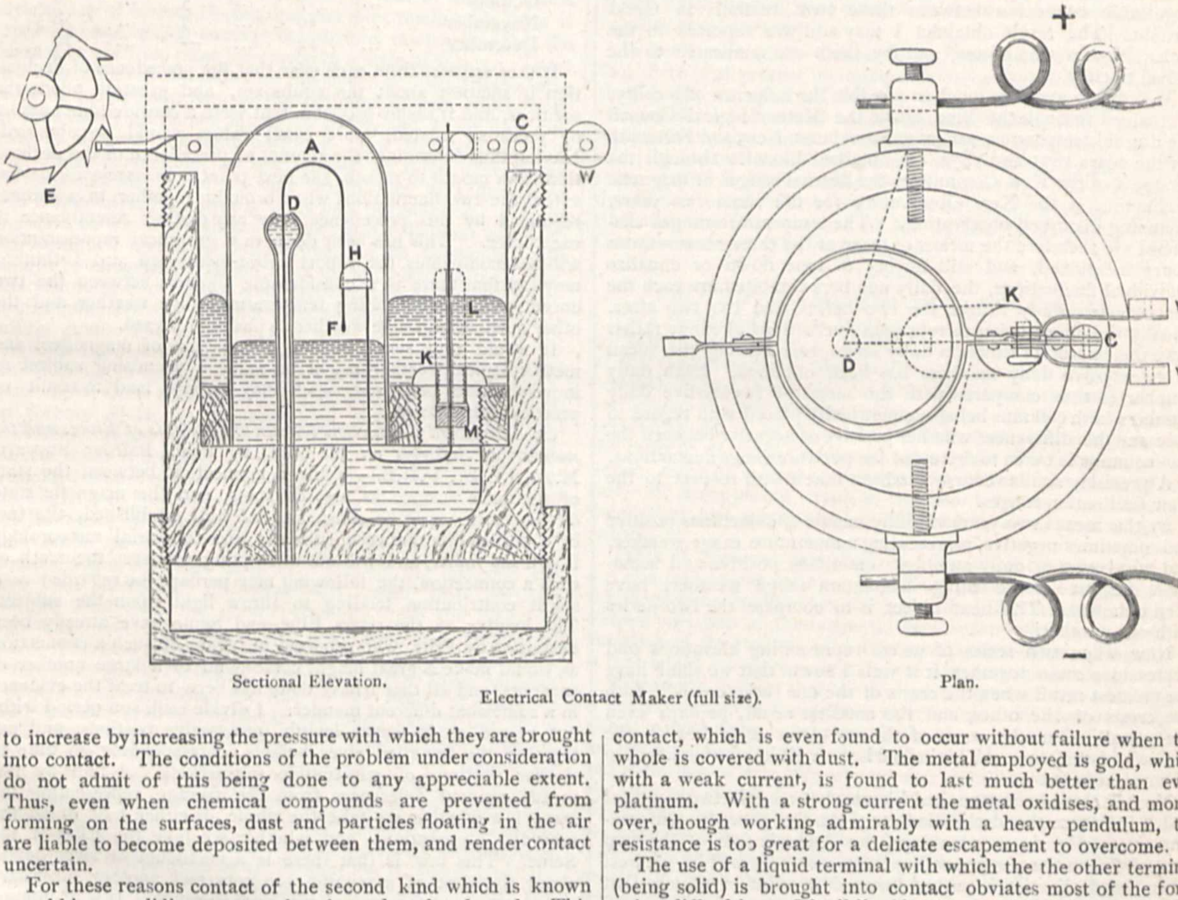
It would thus seem as if a comparison of magnetical and meteorological weather might be made a promising subject of inquiry besides being one which may perhaps lead to results of practical importance.

On a Supposed Connection between the Heights of Rivers and the number of Sunspots on the Sun, by Prof. Balfour Stewart, M.A., LL.D., F.R.S.—While a connection between the state of the sun's surface as regards spots, and the magnetic state of the earth, may be considered as well established, the fact of a connection between sunspots and terrestrial meteorology is still *sub judice*, and without attempting to assert the truth of such a connection, the following may perhaps be regarded as a slight contribution tending to throw light upon the subject. The heights of the rivers Elbe and Seine have already been examined by Fritz, who reported in favour of such a connection as would make a great height correspond to a large number of sunspots, and all that I have done has been to treat the evidence in a somewhat different manner. I divide each sun period without regard to its exact length into twelve portions, and put together the recorded river heights, corresponding in time to similar portions of consecutive sun-periods. I find by this means residual differences from the average, representing the same law whether we take the whole, or either half of all the recorded observations, and whether we take the Elbe or the Seine. This law is that there is a maximum of river height about the time of maximum sun-pots, and another subsidiary maximum about the time of minimum sunspots. It is of interest to know whether the same behaviour is followed by the River Nile. Through the kindness of General Stone Pacha, and through the Science and Art Department, South Kensington, information has been obtained about this river. This information shows us that the Nile agrees with the European rivers in exhibiting a maximum about the times of maximum sunspots and a subsidiary maximum about the time of minimum sunspots, only the subsidiary maximum is greater than for the European rivers already named. It also appears that the date of maximum height of the Nile is latest on these years for which the yearly height is greatest. Now the present year is, perhaps, not very far removed from a solar maximum, and I am thus induced to think that the Nile may this year be somewhat late in attaining its maximum rise.

Contact Makers of Delicate Action, by Prof. H. S. Hele Shaw.—The author has been engaged in designing a speed indicator in which it is essential to have the uniform motion of a revolving disk. This disk is subject to varying resistance, so that for driving it, clockwork, even though powerful and expensive, could scarcely be depended upon. It therefore seemed best to employ an electro-magnet acting on a ratchet wheel and controlled by a clock. This clock for the purpose might then be a common one, with lever escapement. Upon enquiry there appeared to be no contact maker at once, absolutely reliable, suitable for continuous use, and at the same time sufficiently delicate in its action.

In an instrument of this kind for completing circuit it is necessary to ensure such a close approach of the surfaces forming the opposite poles as practically amounts to absolute contact. With small differences of potential and without previous contact, the exact distances across which the current will flow appears to be at present unknown. According to Prof. Guthrie the terminals of 50 or 60 grove cells may be brought to within 1-1000th of an inch without any indication of the passage of a current. Prof. Tyndall says that a battery of more than 1000 cells is required to cause a spark at 1-1000th of an inch, and Prof. Sylvanus Thompson mentions 1-10,000th of an inch as the distance. To ascertain the quantity exactly, appears impossible without the use of an instrument of such refinement as Whitworth's millionth measuring machine, a modification of which might be very appropriately employed for the purpose. The distance no doubt is extremely small, and the consequent difficulty in the way of ensuring electrical contact when the opposite poles are the surfaces of two solids, seems to merit a brief consideration.

The ways in which two such surfaces are brought together may for convenience be divided into (1) a relative motion of the two terminal surfaces, normal to both; (2) a motion tangential to both; (3) a motion compounded of these two. The first mode is very common with rapid contact makers, such for instance of those with electric bells and telegraphic transmitters, but these require an appreciable amount of force to work them. That contact makers of this kind are not suitable with delicate clocks is the testimony of every clockmaker to whom the author has spoken. One of these instruments of very delicate construction required the weight of nearly one gram to ensure electrical contact, and then could not be entirely relied upon. There is no doubt that when two surfaces of solids touch only lightly the area of contact is exceedingly small. This area may be made



Sectional Elevation. Plan.

Electrical Contact Maker (full size).

to increase by increasing the pressure with which they are brought into contact. The conditions of the problem under consideration do not admit of this being done to any appreciable extent. Thus, even when chemical compounds are prevented from forming on the surfaces, dust and particles floating in the air are liable to become deposited between them, and render contact uncertain.

For these reasons contact of the second kind which is known as rubbing or sliding contact has been largely adopted. This action may be made perfectly reliable, and is suitable where the motion is not rapid as for instance with switches and commutators. But considerable energy may be absorbed in overcoming friction. Those clockmakers who employ it, appear to do so only for large clocks. The third method has, as far as the author is aware, been adopted in only one way, though in that way with eminent success. A contact maker of this kind is used by Mr. Hargreaves of Leeds, who has had it at work for fifteen years. A metal roller with rounded edge runs upon and between two metal rails of circular section, thus making contact between them. Contact is broken when the roller passes over a gap or joint to another pair of rails. When the roller is moving along the rails, there is a slight rubbing action, by reason of its resting between them. This is almost certain to produce electrical contact, which is even found to occur without failure when the whole is covered with dust. The metal employed is gold, which with a weak current, is found to last much better than even platinum. With a strong current the metal oxidises, and moreover, though working admirably with a heavy pendulum, the resistance is too great for a delicate escapement to overcome.

The use of a liquid terminal with which the the other terminal (being solid) is brought into contact obviates most of the foregoing difficulties. Of all liquids mercury is the only one which can be practically employed. There are two objections to its use which have hitherto prevented its being used for more than temporary and experimental purposes:—

1. The fact that it readily combines with oxygen on the passage of an electric spark.

2. The difficulty of rendering a contact maker of this kind portable.

The author has endeavoured to overcome the first of these by causing contact to be made in a gas which has no action on the mercury. The way in which this is done is as follows: A short glass tube closed at its upper end (such as an inverted test tube) is filled with mercury, and inverted in a vessel of mercury. The mercury is then partially displaced by hydrogen gas. A very light bent lever working on a pivot is connected with a platinum wire, which passes through the mercury into the gaseous space. It there makes contact between the mercury below, and a smaller quantity in an insulated capsule within the tube. The lever is worked from the outside by mere contact with the escapement wheel of an ordinary clock, which owing to its extreme sensitiveness is quite sufficient to do this. The positive and negative poles of the terminals are connected respectively with the mercury in the capsule and that in the vessel. It is evident that although the lever is always in electrical contact with the mercury in the vessel, the circuit is only completed when it is brought into contact with that in the capsule.

Various experiments have been made with this instrument, and the result has been completely satisfactory. With a battery of fifteen Grove cells the surface of the mercury was brighter at the end of half an hour than at the beginning of the experiment, although a much more brilliant spark was visible than when contact was made in air. After three weeks of intermittent working for periods of sometimes as much as twelve hours but with weaker batteries, the mercury remained quite clean.

The present form of the instrument is shown in the annexed figure. The general action is similar to the one already described A, being the gaseous space, D, the capsule of mercury, E, the escapement wheel. The chief improvements to be noted are:—

1. Contact is made and broken at F instead of at D, thus preventing sensible loss by volatilization from the small quantity of mercury in the capsule. The wire D F is insulated from the bent lever by the glass junction at H.

2. Portability is secured by having a plug, K, shown in dotted lines, which can be screwed down and a gland L, by means of which the wire can be packed by an india rubber washer, M. The lever and balance weights, W W, are made to go within the lid which can be taken off the bottom and screwed on to the top (as shown by the dotted lines). This keeps in any loose mercury above the plug.

3. The lever is so arranged that contact is only of momentary duration, a point of no little importance in connection with the constancy of the battery.

SECTION C—Geology

On the Geology of the Channel Tunnel, by Prof. W. Boyd Dawkins, F.R.S.—He laid special stress on the fact that the line of faults both on the English and French coast are small, neither of them have throws of more than 38 feet, and even this magnitude is rare, he therefore considers the chances of the older porous rocks being thrown by them is well nigh impossible. He considers, however, that in some cases this fault acts as ducts conveying water downwards, and he ascribes to one of these faults the well-known springs on Abbot's Cliff, known as the "Lydden Spout." 1. The lower beds of the chalk marl and the lower part of the grey chalk, are the only strata in the chalk sufficiently impervious to allow of the construction of a tunnel in the dry. 2. That the outcrop of the chalk marl between Folkestone and the Shakespeare Cliff, is the best position for a tunnel, which could strike the lower part of the chalk marl, and remain in it throughout, so as to join the workings of the French Channel Company, which are being carried on in the same horizon. 3. That the faults in the lower part of the chalk would not now allow of free percolation of water, and are not likely to become a serious obstacle to the work. 4. That the strata above the chalk marl are so porous and traversed by open fissures that they allow of free access to water both sub-aërial and marine. He considers that on the French side the rocks are far more shattered and faulted, and more open to be traversed by water, which is now, however, being successfully contended with by the French Company. The author refers to analyses made of samples of cretaceous rocks. Insoluble material in gault was 45 per cent.; chalk marl (No. 1), 75 per cent.; and only 6 per cent. in the more soluble part of the grey chalk; over the yellow chalk 18 per cent.; while above this it is only 2 per cent. in the lower white chalk without flints. He described the work done by Sir John Hawkshaw in having soundings taken in the English Channel to ascertain the character of the Channel bottom.

On the Proposed Channel Tunnel in its Geological Aspects, by C. E. De Rance, F.G.S., described the sub-divisions found in 1874 in the chalk of Abbott's Cliff, by Mr. Hilton Price and himself, and the impermeable nature of the lower beds, which support a sheet of water met with in springs at the outcrop, and in wells at various points. He regards these underground waters as circulating in the porous white chalk under the sea, and he considers that the artificial abstraction of water by pumping, in making the proposed tunnel in St. Margaret's Bay, will allow the percolation of sea-water to the extent of a million gallons of water in each mile driven daily, and therefore offers great difficulties in the way of the construction of a sub-marine tunnel which are not presented by the lower beds of the chalk marl.

Evidence of Wave Action at a Depth of 40 *Fathoms in the English Channel*, by A. R. Hunt, B.A., describes 16 localities in which pebble have been dredged off the Start Point in 34 fathoms of water, and the discovery of a soda water bottle covered with Serpulæ, and containing 36 species of shells which have been washed in, at a depth of 40 fathoms, by a Brixham trawling fishing boat.

List of Works on the Geology and Palæontology of Oxfordshire, Berkshire, and Buckinghamshire, by W. Whitaker, B.A.—This is a continuation of the County or District Lists, of which a catalogue was given at the head of the Welsh List in the Report for 1880; the present list contains nearly 300 references.

On the Equivalents in England of the "Sables de Bracheux," and of the Southern Limits of the Thanet Sands, by J. Prestwich, M.A., F.R.S.—The author dwells on the importance of establishing in adjacent separate basins, a certain number of well-defined horizons. The lignitic and freshwater beds of the Paris Basin, and of the Woolwich and Reading series, form one such, but he considers the correlation of the beds beneath to be not yet satisfactorily established. The author correlates the Mancheux sands with the lower ends of the Woolwich series, and he is confirmed in this view by M. Desharges, and he further is of opinion that the Thames sands are absent in the Paris Basin.

On the Formation of Flints, by Prof. W. J. Sollas, M.A.—Flints are siliceous pseudomorphs after chalk. Three different stages in their formation are to be distinguished: (1) the silicification of the foraminifera, coccoliths, and calcareous granules of the chalk gives rise to *siliceous chalk*; (2) a deposition of silica follows and produces white or *grey flint*; (3) as the deposition of silica continues it fills up and obliterates the pores of the opaque grey flint, rendering it black and translucent, thus the common *black flint* results. Flint nodules are sometimes found in which all three stages are still represented, but more frequently only the last two: thus grey spots and blotches are seldom absent from black flint, whilst in many cases the two kinds regularly alternate and thus produce the phenomenon of banded flint, which has up to this time remained without any satisfactory explanation.

On some Fossils from the Inferior Oolite, by the Rev. G. F. Whidborne, M.A., and Prof. W. J. Sollas, M.A.—Describes bivalve shells of mollusca chiefly in the Jermyn Street Museum, and 8 new species of sponges, of which 4 belong to 4 new genera.

Mention of an Example of an Early Stage of Metamorphic Changes in an Old Red Sandstone Conglomerate near Aberfoil, by Prof. James Thomson, LL.D., F.R.S., describes fractured quartzite pebbles which he regards as originally a plastic body, which first bent, and then broke, and that the present brittle appearance has been induced at a late era, and he refers their origin to metamorphic action.

On Features in the Glacial Workings noticed on Sandstone Conglomerate at Skelmorlie and Aberfoil, by Prof. James Thomson, LL.D., F.R.S., describes a railway cutting half a mile from Aberfoil. At 150 to 200 feet above the sea occurs striated sandstone, on which were glaciated pebbles, behind which occurred tails of fine material, 5 or 6 feet in length, in the direction in which the ice travelled. Examples have been found by the author showing distinct traces of the ice moving up hill.

Problems in the Geology of the Channel Islands, by the Rev. E. Hill, M.A., states the work done by the late Prof. Ansted leaves much to complete, and is of opinion that there is here a fine field for detailed investigation.

Notes on the Geology and Mining of the United States of Columbia, S.A., by R. B. White.—This paper gives an exhaustive report of the range of metals in time and space in this region, and the application of facts observed, to other districts.

Suggestion for a Revised Classification of the British Eocene, by J. S. Gardner.—Some modification in the classification of the Eocene has become desirable, through the transfer of the Upper Eocene group of Edward Forbes to the Oligocene formation. The discovery of several distinct floras seems also to necessitate certain alterations in order to bring periods founded originally on changes in mollusca into harmony with the more striking changes indicated by the plants. A grouping is suggested which separates the London Clay from the Lower Eocene, and brackets it with the Lower Bagshot Beds as a Middle Eocene. The Middle Bagshot series forms the Upper Eocene, while the Upper Bagshot may remain a member of the same formation, or find a place in the Lower Oligocene. Refers to the changes of climate in the Tertiary epoch.

On the Classification of the Oligocene Strata in the Hampshire Basin, by J. W. Elwes, describes results of investigations in Hampshire and the Isle of Wight. In the latter district he considers that Prof. Edward Forbes was correct in stating that there is only one marine series in the Headon and Brockenhurst group, but he considers, with Prof. Judd, that there are at least two marine zones, the Brockenhurst zone, lying at the base of the series, instead of above the Middle Headon *Venus* bed. The author found the southerly dip at Totland Bay, as described by Prof. Judd, bnt found no evidence of the local flexure described by that author, by which the latter explains this section, in opposition to the view of the late Edward Forbes.

On the Outcrop of the Brockenhurst Beds near Lyndhurst, by E. Tawney, M.A.—Fossils characteristic of the rich beds which he had been lately working in the railway cutting near Brockenhurst, were found by Mr. H. Keeping, at Cut Walk Hill, Lyndhurst, in 1858. The well at Emery Down, closely adjacent also, yielded the same fossils in 1863. The excavations which the author had lately carried out with the assistance of the Rev. J. Compton, of Minstead, on several sides of this hill, show the succession of the beds to be on the base of the hill. Upper Bagshot sands, next in ascending order, freshwater Lower Heaton, Marine Brockenhurst bed, *Voluta geminata* zone, followed by beds not explored, concluding with the freshwater Osborne marls on the top of the hill. The succession is therefore that of Whitecliff Bay. The thickness of beds between the freshwater Lower Heaton and the Osborne marls is about 100 feet. The discovery of freshwater Upper Heaton beds at Roydon brick-yard was announced.

SECTION D—Biology

Department of Zoology and Botany

On a New Principle affecting the Systematic Distribution of the Family of the Torpedinidæ; and on the Probable Occurrence of the T. Occidentalis (Storer) on the British Coast, by Prof. Du Bois Reymond, F.R.S.—The author referred to the researches of Prof. Babuchin, of Moscow, on the development of the electrical organs of Torpedo, who has established that these organs are formed by the metamorphosis of striated muscle, and that as they grow they increase in size, not by the addition of new columns and septa, but by the growth of the columns and septa, so that the number is the same in adult and young specimens. He then passed on to the consideration of the part which this fact—known as "delle Chian's and Babuchin's Law—plays in the distribution of the Torpedinidæ. He thought that the average number of columns ought henceforward to form a part of the diagnosis of the species of Torpedinidæ—a matter which has hitherto been entirely overlooked by zoologists. He referred to the species of Torpedo of John Hunter, and showed how Hunter's conclusion that the columns increase in number as well as size was erroneous, and described fully the *T. occidentalis* on the British coasts.

On Cephaliscus, a New Form allied to Rhabdopleura (Allman), by Prof. McIntosh, F.R.S.—This new form was very fully described, and its relation to Rhabdopleura of Allman, which we know as a somewhat abnormal Polyzoön, was discussed. It differs from *Rhabdopleura* in regard to the *cœnœcium*, in the much greater size of the buccal shield, in the remarkable branchial or textacular plumes, in the structure of the pedicle, and the perfectly free condition of the polypides. Cephaliscus and Rhabdopleura agree in the absence of the calyciform membranes connecting the bases of the tentacles, in the position of the mouth, which opens behind the buccal shield, in the general structure of the alimentary canal, and in the position of the anus. The development of the young buds is similar. Both forms connect the ordinary Polyzoa with *Phoronis*.

On an Instructional System of Arrangement in Provincial Museums, by F. T. Mott.—The author suggests a combination of a typical collection of the entire fauna of the globe with that of the local species, the latter being on the ground row, both scientific and vernacular names being given on labels corresponding with a cheap popular guide-book.

Injurious Parasites of Egypt, by Dr. Cobbold, F.R.S.—Egypt is a grand field for the helminthologist, since not only is that country the headquarters, so to say, of one of the most dangerous of human parasites, but it swarms with others possessing scarcely less practical importance, whilst it likewise enjoys the distinction of having made us acquainted with parasitic rarities not known to occur in any other part of the world.

The most dangerous parasite is *Bilharzia hæmatobia*. This was so named by me in honour of Dr. Bilharz, who first discovered it at Cairo in 1851. A few years later I detected the same species of parasite in a monkey; and since the year 1856 confirmatory discoveries and observations, made both at home and abroad, have very greatly extended, though they have by no means completed, our necessary knowledge of the natural history of the creature. In this connection it is fitting that we should signalise the labours of Dr. Prospero Sonsino, whose residence in Egypt has enabled him to contribute facts of great interest. It is to Sonsino that we owe our knowledge of the fact that cattle and sheep are also liable to be infested by *Bilharzia*, but the species is not the same as that which invades man and monkeys.

The *Bilharzia* is a genuine fluke parasite of the digenetic kind, and therefore requiring a change of hosts. It differs from the ordinary sheep-fluke and its allies in being unisexual. In other words we have male and female *Bilharziæ*, the male being the stouter of the two sexes. This is an unusual circumstance amongst parasites. Again, these *Bilharziæ* differ in respect of habitat, for, instead of occupying the liver-ducts and intestinal tract, as most flukes do, they take up their abode within the blood-vessels of the victim.

Although the parasites are individually small, the slender females being less than an inch in length, the presence of any considerable number of them gives rise to a formidable malady, which, in some cases, proves fatal. The disorder thus occasioned has received various names, but it is sufficient to speak of it as the *endemic hæmaturia* of warm climates. Dismissing the purely professional aspect of the affection, and viewing the matter as a question of public health specially affecting European residents in Egypt, I may state that I have recently seen six officers of the Eastern Telegraphic Company, who contracted the disorder in the neighbourhood of Suez, and also another gentleman who obtained the parasite in Natal. In all of these instances the immediate cause of the parasitic invasion was due to their having carelessly drank unfiltered water. In all the Egyptian cases this took place during shooting expeditions along the banks of the Cairo-Suez Canal.

Thus, all the evidence of a practical sort that we have obtained as to the cause of the endemic is in perfect harmony with that which has been derived from scientific inquiry. So far as our investigations have been pushed, it is clear that in respect of *Bilharzia hæmatobia*, the natural history phenomena do not differ in any very essential particular from those that occur in the case of ordinary flukes. We have a similar mode of origination, the same rapid growth and development attended with metamorphosis, and likewise a change of hosts.

Practically it is of little moment what water snail or other aquatic organism holds the cercaria of Bilharzia. Infection follows as well from the ingestion of the free-swimming cercaria as from the ingestion of the intermediate hosts. It comes to the same thing in the end. Canal water-drinking in Egypt is the direct cause of the Bilharzia infection, and of the consequent endemic hæmaturia. This being so, simple filtration is in most cases a sufficient protection. To European residents, therefore, the drying up or damming up of the fresh-water canals is not an unmixed evil, because it insures greater freedom from parasitic dangers; moreover, it induces efforts to remedy the evil. Of course these efforts will correspond in magnitude with the necessities of the case.

Unfortunately, there are other parasites whose entrance into the human body by means of water-drinking is of constant occurrence, and they are often found associated together in one and the same person. The other specially obnoxious endemic worms are *Anchylostoma duodenale* and *Filaria sanguinis hominis*. Speaking of the collective *rôle* of the three parasites, Dr. Sonsino says that "they concur in the production of a large mortality of the natives," and the mischief they thus occasion "is not sufficiently appreciated."

How fatal the *Anchylostoma* may prove in other countries than Egypt was recently seen in the endemic outbreak which carried off some of the labourers during the formation of the St. Gothard Tunnel. Many disputes and misunderstandings at first prevailed respecting the *rôle* of this Entozoon. Having been called "tunnel trichinosis," this disorder got sadly mixed up with affections having a totally different character and history. Similarly, the blood-letting habits of *Bilharzia* and *Anchylostoma* having produced analogous symptoms, the two disorders were called Egyptian chlorosis, intertropical anæmia, and so forth. Recently our knowledge of the geographical distribution of the Anchylostoma has been extended by the discovery of Prof. McConnell, who finds that the parasite is more or less prevalent in India. Wherever it is to be found, its power for mischief is the same, and its mode of entrance into the human frame can only occur through the medium of water.

As regards dangers arising from external attacks by water parasites, little need be said. Troops invading foreign lands are now better furnished than formerly in the matter of clothing and other protective aids; still there are points worth mentioning, especially as in the heat of a campaign the distress from thirst often compels the soldier to drink the filthiest of waters. One quotation will suffice During the invasion of Egypt by Napoleon, the French soldiers were much distressed, and often laid themselves flat on the ground to drink. Their mouths and nostrils were thus attacked by leeches. The species responsible for these assaults is the *Hæmopis sanguisorba* of Savigny. These free parasites not only attacked the men, but also their horses, camels, and cattle.

On the Brown Coloration of the Southampton Water, by Arthur Angell, Ph.D.—The author has found that this coloration is very irregular, and even occurs in isolated patches; he showed that the coloration is due to a brown organism (*Pendinium fuscum*); he has been able to obtain from it brown and green solutions, which both give the spectroscopic appearances characteristic of chlorophyll. He discussed its probable animal or vegetable nature, but favoured the latter view.

Department of Anatomy and Physiology.

Dr. Fraser proceeded to the description of his results on the early development of certain rodents, illustrating his remark by drawing on the board. He showed that the guinea-pig, instead of standing isolated among mammalia by its peculiar form of development, shared this isolation among rodents with the rat and the mouse. He traced the history of the ovum from the sixth day after union of the sexes, up to the formation of the allantoic circulation. Dr. Fraser, whose work is still incomplete, but who is at present busy with the earliest condition of the ovum, offered no explanation of this important result. He insisted, however, upon the hypoblastic layer being external from the close of segmentation, and that the inversion of the layer therefore existed in these three animals from the earliest segmentation phenomena.

Prof. Allen Thompson made some remarks upon the general excellency and result of the work as changing our ideas on the mammalian development, and stated that as Kölliker had just found the hypoblastic layer in the amnion of the rabbit, we must be prepared for great changes in our received opinion on this subject.

On the Homologies of the long Flexor Muscles of the Feet of Mammalia, by G. E. Dobson, M.A., M.B.—Dr. Dobson dealt with the homologies of the following muscles:—Flexor Digitorum fibularis = Flexor hallucis longus; 2. Flexor Digitorum tibialis = Flexor Digitorum longus; 3. Tibitalis positicus. He explained by means of drawings how these muscles partially or totally supplanted one another in different animals. From the examination of a large number of animals he fonnd the *flexor fibularis* existing in all and exhibiting but few modifications, while the other two were subject to much variation, or might be absent. He deduced from his dissections that the variation of the *flexor tibialis* had not been properly understood, its real homologues having been named *tibialis porticus accessorius secundus*, or *internus*, while it was supposed the muscle had undergone fusion with the *flexor fibularis*.

On the Nature of the "Telson" and "Caudal fusca of the Crustacea," by M. M. Hartog, M.A., D.Sc.—Dr. Hartog sent a short paper to explain that the telson in the higher crustacea is equivalent to the last segment of the Nauplius body, together with an immensely developed postanal portion composed in varying proportions of the supra-anal plate and the adnate fuscal processes. The fuscal processes he regards as outgrowths of this telson not strictly comparable to limbs, but rather to the primitive-paired outgrowths of the body-segments which have become limbs elsewhere by the development of basal articulations and a proper musculature.

Considerations arising from Koch's Discovery of the Bacillus of Tuberculosis, by F. J. Faraday, F.L.S.—Two great discoveries, Pasteur's discovery of the decreasing virulence of specific disease germs when kept in the presence of oxygen, and Koch's discovery of the bacillus of tuberculosis, have been made within the past two years. The author suggests a possibly useful relation between these discoveries. Referring to the suggestion of Dr. William Roberts, F.R.S., of Manchester, in his address to the Medical Association in 1877, that disease germs may be "sports" from harmless saprophytes which have acquired a parasitic habit, he asks whether deprivation of oxygen, or cultivation in gaseous mixtures from which the normal supply of free oxygen present in good air is absent, may not have an influence in converting harmless germs present in the atmosphere into the bacilli of tuberculosis. He refers to Carl Semper's researches on the influence of the environment on animal modification, and to the fact that many larvæ of insects live in situations where the air is undoubtedly mixed with gases which the higher vertebrata could not breathe without injury, and suggests that the adaptability of organisms, and their impressionability by surrounding conditions, may increase as the scale of life is descended. He also refers to a paper by Mr. Frank Hilton, F.C.S., read before the Chemical Society, on experiments with bacteria in various gases. Mr. Halton gave the chemical results, but it would be interesting to know the influence of cultivation in such media on the character of the bacteria themselves. Dr. Angus Smith has argued that the putrefying process, when carried on in confined places, such as sewers, may develop disease germs which are not developed when the same process goes on in unconfined places; typhoid fever seems to be developed by processes in sewers, which, carried on in the Clyde, for instance, do not originate any well-marked disease. Analogous conditions may be presented in the lungs of persons engaged in dusty trades, breathing vitiated atmosphere in ill-ventilated rooms, or engaged in sedentary occupations, and not taking healthy exercise; and also in the lungs of persons who are hereditarily narrow-chested, weakly, and of feeble inspiratory habit. Innoxious germs present in the atmosphere may be inhaled and retained in the lungs of such persons, and there by successive culture and deficient aëration acquire a parasitic or deadly character. The author refers to Pasteur's method of restoring the virulence of "attenuated" germs by successive culture in the bodies of different animals, as possibly explaining the communication of tuberculosis to persons of sound constitution, the parasitic habit of the tubercle "sport" being so strengthened and confirmed by successive culture under the assumed favourable conditions as to enable it eventually to establish itself under certain conditions in a *milieu* which would not be suitable for the origination of the culture. He refers to a new treatise by Dr. Ferdinand Kroczak, of Brünn, entitled "Die Heilung der Tuberculose," and shows that Dr. Kroczak's arguments in support of the special treatment recommended by him are in harmony with the hypothesis advanced.

The decrease of mortality from consumption in the army since the improvement of barrack ventilation, and the relief afforded to patients by sea-voyages, the air of pine-woods, carbolic acid inhalations, and other suggested remedies, is also referred to as giving support to the hypothesis.

On the Kidneys of Teleostei, by W. Newton Parker. In following the investigations of Prof. Balfour, who showed that in certain adult Teleostei, as well as in Lepidosteus and Accipenser, the so-called "head kidney" contained no urniferous tubules, but was composed entirely of highly vascular lymphatic tissue, the author finds that in some Teleostei the so-called "head-kidney" has precisely the same structure as the rest of the kidney in mesonephros. He nevertheless holds that Prof. Balfour's view is correct, and explains the circumstance by supposing that the mesonephros has grown forwards so as to take the place of the larval pronephros.

On the Perception of Colour in Man and Animals, by Dr. S. D. Macdonald, R.N.—Dr. Macdonald read a paper, in which he endeavoured to show the near relationship of perception of sound and light, comparing different colours to different notes.

On the Structure of the Muscular Tissue of the Leech, by T. W. Shore.—The author described his research, summing up as follows:—1. The muscle of leech consist of elongated tubes with two coats—a sarcolemma and contractile layer—the inner surface of which is irregular, and gives rise to an apparently granular contents. 2. In living condition it is unstriped. 3. There are no nuclei. 4. Transverse striation may be produced post-mortem, the result of three changes:—α. Regular arrangement of the papillæ on the inner surface of the contractile layer. β. Folding of the surface of the sarcolemma. γ. Splitting into segments of the contractile substances which subsequently contract. 5. The contractile substance coagulates, forming myosin, which subsequently contracts. 6. The rapidity of contraction gives rise to varying appearances of fissures, striations, &c.

An Improved Method of Direct Determining of the Contraction Wave in Curarised Muscle, by E. A. Shaafer, F.R.S.—In this method, instead of using levers which write directly on a blackened surface, the levers are caused to successively break galvanic circuits connected with a Ruhmkorff induction apparatus, the ends of the secondary coil being so arranged that the sparks are transmitted through a sheet of smoked paper, turned rapidly by means of a spring myograph. A time tracing is at the same time recorded on the paper.

On the Presence of a Tympanum in the Genus Raca, by G. B. Howes.—The author regards a fenestra (long known to exist) in the roof of the auditory capsule of the genus and its adjacent parts, to be a modification of what is seen in other species, which is correlative of the compression from above downwards undergone by it, resulting in the formation of a tympanum physiologically foreshadowing the essential process involved in the elaboration of the auditory organ of the higher forms.

Prof. H. N. Martin, D.Sc., explained briefly his method of isolating the mamalian heart for experimental purposes.

Dogs were used: these being etherised, were then kept alive by artificial respiration; all systemic vessels, with the exception of the thoracic aorta and the superior cava were then ligatured. The heart is now supplied by defibrinated dog's or calf's blood by means of a Marriot's flask, the whole animal being kept in a moist and warmed chamber. Dr. Martin by these means has found that either the venous or aortic pressure may be varied in very great limits without the rate of the beat being altered, but by increasing the venous pressure very slightly, the work done by the organ was vastly increased. These researches are, however, only preliminary.

On some Toxic Conditions of the Blood illustrated by the Action of Hydrocyanic Acid, by T. S. Ralph.—Having found some apparently amyloid matter in the blood-corpuscles of patients taking hydrocyanic acid, Mr. Ralph has examined the subject, and brought forward some observations which tended to show that this may occur in recent paralysis, and the exhibition of various remedies.

Department of Anthropology

Evidence as to the Scene of Man's Evolution and the Prospects of Proving the same by Palæontological Discovery, by W. S. Duncan, M.A.I.—Mr. Duncan urged that a Committee should be appointed to investigate fossil forms proving the evolution of man. The author advanced a series of arguments in favour of the region of the South of Europe and Asia as the probable scene of man's evolution as a likely field of successful exploration.

Ebb and Flow in Mental Endowment, by G. Harris, F.S.A.—The theory propounded by Mr. Clarke was that an ebb and flow in mental capacity and moral quatities may often be discovered in the successive generations of particular families. The writer referred to the supposed transmission of endowments acquired by cultivation, and started the inquiry whether the condition of the parent at the time of procreation of the child is that from which the transmission of such qualities is derived.

On some Customs of the Aborigines of the River Darling, New South Wales, by F. Bonney.—Mr. Bonney gave the result of his own observations, during many years' residence, on the customs of the race, and especially on the rites and ceremonies relating to marriage, coming of age, burial, mourning, &c., and an account of the many superstitions relating to the healing art, detection of murderers, &c. The paper was illustrated by a large number of valuable photographs.

The Light thrown by the Explorations of Caves on the Conquest of Britain, by Prof. Boyd Dawkins, F.R.S.—The lecturer brought forward much important evidence drawn from the exploration of caves in Ayrshire and other localities as to the places to which the Britons retreated as the advancing Anglians spread westward.

SECTION G—MECHANICAL SCIENCE.

Mr. B. Baker read a paper on *The Forth Bridge*, of which we recently gave an account, (*Nature*, vol. xxv. p. 246). The author gave an amusing illustration of the size of this new bridge. The stature of a new born infant being 19·34 inches, the average height of a guardsman 5 feet 10½, the ratio of these two is as 1 : 3·65, and this is exactly the ratio of the span of the Forth bridge to that of the largest bridge at present in this country, viz. the Britannia bridge. The account above alluded to dealt principally with the questions of size and strength; the paper in addition to these points dealt with the history of negotiations and Parliamentary proceedings, and then with mode of construction, weight of materials to be used, and probable cost. No less than 42,000 tons of steel will be used in the superstructure of the main spans and 3000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations would be about 150,000 cubic yards, and the estimated cost of the entire work was about £1,500,000 though from the magnitude and novelty of the undertaking this must be regarded as only an approximate figure. A very fine model of the proposed bridge was placed in the room.

On the Treatment of Steel for the Construction of Ordnance, by Sir W. Armstrong.—The author alluded to the want of a proper definition of steel. The term was formerly confined to iron containing a much greater proportion of combined carbon than was to be found in the so-called mild steels of the present day. The chief distinction between iron and steel now seemed to be in the process of manufacture, steel being operated upon in the state of fusion, while iron was dealt with in a state of agglutination. But even mild steel contained more carbon than was generally to be found in wrought iron and that excess small as it was, appeared to exercise a very important influence upon its qualities. These qualities had been brought out in a marked way in some investigations he had occasion to make in welding, tempering, drawing, and annealing. The experiments were then detailed and the specimen of steel shown to the meeting. One important conclusion was that there was much less sacrifice of ductility and toughness in obtaining strength by tempering, than by increase of carbon. The saving in weight of steel for a given purpose would thus in the case of bridges and similar structures, amply repay the cost of tempering.

Mr. T. R. Wrighton read a paper on *The Increased Tenacity in Perforated Test Bars of Iron and Steel* which together with the former paper elicited a very interesting discussion, particularly with reference to the curious phenomenon dealt with in the latter. Several explanations of the result have been given, but it appears tolerably certain that the section of the test bar under tension is not decreased to the same proportial extent when perforated as when solid, and this the author appeared to think was due to the cutting through of the diagonal lines of stress by the drilled holes.

On the Channel Tunnel, by Mr. J. Clarke Hawkshaw.—The author commenced by giving an account of the steps which had hitherto been taken in the matter, stating that there were two schemes for carrying out the work. That by the South Eastern Company was the one of which the public had hitherto chiefly heard, while the Channel Tunnel Company had been silent, waiting for the promised Parliamentary enquiry. He then proceeded to discuss the geological aspect of the question in a most able and explicit manner. The plan he advocated may be briefly described as one to bore a tunnel which should approach the coast of this country east of Dover so as to enable the line to rise by the necessary gradient to the town. He proposed to take the shortest possible route and instead of deviating from the straight line to avoid the chance of coming upon water bearing fissures, to aim rather at dealing with the water from this cause by powerful pumping apparatus. He argued to show that the amount of water so met with would probably be quite within the power of pumps to deal with. The advantages to be gained from making a tunnel direct from Fainhole to Sandgatte were:—The shortest sea tunnel; as short a land tunnel, as by any line; a greater thickness of chalk through which to tunnel; the best termination for effecting junctions with the existing English railways; and a termination affording facilities for defence at a less cost than elsewhere. He criticised at length other proposed routes, and finally dealt with the proposed system of ventilation.

On the system of Excavating the Channel Tunnel by Hydraulic Machinery, by Mr. T. R. Crampton.—The principal feature in this proposal is that of driving the chalk cutting machinery by hydraulic power, the waste water being discharged into a vessel with the chalk *débris*. Chalk "cream," is then formed by the revolution of a drum in this vessel, and this cream is pumped to the head of the working and discharged.

Three papers were read by Major Allen Cunningham R.E., whose recently published work in connection with the Hydraulic Experiments at Roorkee, gives this country a position with regard to the subject, which it certainly could not previously claim. The following are brief extracts:—*On unsteady Motion in Open Channels:* The motion of water in open channels is essentially an *unsteady motion with interlacing stream lines;* the hypothesis of steady parallel motion is at variance with nature. Single velocity measurements are of little practical use, being only accidental values; the average of a large number is pretty constant, so that the *average velocity* should always be sought. The time needed to obtain these involves a chance of change of the external conditions. In practical hydraulics the forward velocity is the only velocity considered or required. Floats measure this directly; no other instruments yield this quantity readily in large streams. These principles are of great importance, and show that hydraulic experiments must always be tedious and expensive.—*Convexity of the Surface of Streams:* The figure of the transverse section of the free surface of a stream, usually supposed to be convex, is here considered. The evidence is shown to be very small. Some new special experiments are cited. The conclusion is that the surface is probably level across.—*Depression of Maximum Velocity:* The line of maximum velocity in an open channel is usually below the surface. The cause of the depression is obscure. The wind and disturbances from the banks and bed are usually supposed to be the causes. The wind is probably too inconstant. The disturbances from the banks and bed seem an inadequate explanation. The general depression of the maximum velocity on all verticals at all parts of a channel indicates some resistance from above. The motion in open channels and in rivers flowing full shows some similarity with differences in detail fairly accounted for by supposing the air to be an ever present efficient drag or source of resistance to forward surface-flow, less intense than the banks or bed. If this be admitted the hydraulic term "wet border" must be modified so as to include *all parts* of the wet border, each with its own specific resistance.

On Compressed Air as applied to Locomotion, by Sir F. J. Bramwell.—The author dwelt upon the cases in which compressed air might be advantageously employed for this purpose, as for instance in the proposed Channel Tunnel and on tramways. For the latter, some altered means of traction seems for several reasons inevitable. One of these reasons is the undoubted cruelty to horses which is the result of the present system. The fact that compressed air can be satisfactorily used for this purpose is proved by the tramways of Nantes, which for three years and a quarter have been worked by this means. The various difficulties to be expected on any tram-line, such as those from curves and gradients, are to be found on that one which, running beside the River Loire, connects Doulon and Chantonay. The cars run every ten minutes from both ends of the line for fifteen hours each day in summer, and fourteen hours in winter, and during the time above mentioned there has been no hitch whatever. An arrangement called the "Hot Pot" is used to obviate the loss of energy and the inconvenience arising from the well-known fact that air becomes heated when being compressed, and cools upon expansion. The apparatus consists of a vessel of water into which steam is forced at the conclusion of each journey. Through this heated water the compressed air is passed, and is thus at the same time heated and lubricated. An ingenious form of regulating-valve was also described, by means of which a uniform working pressure is maintained, whatever may be the pressure in the air reservoirs. The two contrivances are combined, and together effect: (1) a great saving of power, and (2) a trustworthy mode of regulating the pressure. Details of the engines and pumps at the stations were given, these together working with the high efficiency of 82 per cent., that is, with a loss of only 18 per cent. of the total energy. The expenditure of fuel per day, under the conditions already given, is only 4½ tons of coal, or a little more than 12½ lbs. per mile run.

Three papers were read by Dr. Fleming. The first upon *Recent Progress in Electric Railways* was practically a description of an experimental railway laid down by Mr. Edison in Menlo Park. The plan there adopted is to connect one rail at regular distances with one of the terminals of a dynamo in a central station, the other rail being similarly connected with the opposite terminal. The motor has externally the appearance of an ordinary locomotive without a funnel, containing, however, a dynamo, by means of which short circuiting between the rails is prevented, and the motive power obtained. The percentage of useful effect claimed by the authot was exceedingly high, only 5 lbs. of coal per hour per H.P. being used, as against 6 lbs. with an ordinary locomotive. A speed of 40 miles an hour, over 8 or 10 miles, was stated to have been attained. These statements of the author concerning the efficiency of the system described by him, were called in question by the President, Prof. Forbes, and others, who complained of the meagre supply of facts upon which to form an opinion on such an important question. Dr. Werner Siemens, at the request of the President, made some remarks with reference to his own experience in electric railways, stating the loss of power to be one-fifth in winter, and one-eighth in summer. Amongst other things he advocated overhead connection of wires to convey the current. The other papers by Dr. Fleming were upon electric lighting and the efficiency of the Edison dynamo.

Prof. Forbes described a very simple and ingenious form of electric lamp, and then read a paper giving results of experiments on wires conveying currents, which he had embodied in two laws. These laws define the strength of current which can be sent through wires of different diameters without raising the external temperature above a certain limit. Law I. When the wire is bare and exposed to the air, the strength of current is proportional to the diameter of the wire. Law II. When the wire is wound in coils of the same size and weight, the strength of current is proportional to the diameter of the wire. To discover the first law, a thin coating of wax was put upon each wire, and a current gradually increasing in strength was passed through it until the wax melted. The strength of the current was then read off on a galvanometer. To discover the second law, two equal tubes were wound with many layers of wire until they were of equal weight; these were filled with water and a thermometer bulb inserted. The currents required to raise the temperature in each equally were measured.

Mr. Barlow read a paper *On the Mechanical Properties of Aluminium.* This metal is used chiefly as a substitute for silver, but the author had found it to be exceedingly strong in proportion to its weight. Experiments had been carefully made for him by Prof. Kennedy, from which its valuable properties of ductility, tensile strength, and elasticity were fully demonstrated. This was well illustrated by the comparative length of rods of uniform section, but of different metals, which could be suspended without rupture, the lengths in the case of steel and aluminium being equal and exceeding all others. Unfortunately it is an expensive metal, and the process by which it is at present extracted leaves little hope of its use being greatly extended. Sir H. Bessemer said he did not think any metal could be depended on like the one in question, from the small part its weight took in producing its rupture. He exhibited a key of the material (about the size of a large latch key), and it was stated that 45 of these would only weigh one pound.

Mr. A. Giles read a paper on *The Southampton Docks.* This paper was listened to with considerable interest, from the fact of proposed local changes, which, if carried out, would considerably affect the port. The paper not only gave a history of the present works, and dealt with the future improvements, but also gave statistics of the trade of the docks as a commercial undertaking.

Mr. Price Edwards read a paper *On Sound Signals*, discussing the various signals used on railways, ships, and the coast. He stated that a change was about to be introduced in connection with the Trinity House signals, in which a combination of high and low notes was to be used. A trial of explosive signals was also shortly to be undertaken. Allusion was made to the unnecessary shrillness of railway whistles.

Prof. W. C. Unwin read a paper on *Current Meter Observations in the Thames.* The author described and exhibited the instrument which he had used. This meter differs from most other meters in its mode of suspension, being lowered into the water by a stout wire from a boat, proper orientatian being secured by a tail or vane. The instrument is very convenient to use, observations being taken by one observer at an average rate of one in three minutes. The results obtained were exhibited by curves.

Sir F. J. Bramwell exhibited and explained the action of a speed indicator. This instrument had been designed and employed by him in connection with experiments upon railway trains. It consists of a drum turned by clockwork, over which a continuous slip of paper passes. This paper is marked by two pencils which can at any time be brought into contact with it. One of these gives a straight line which shows the beginning, ending, and line of duration of an experiment. The other receives a reciprocating motion from one of the wheels of the locomotive, und so gives a continuous series of curves, the relative closeness of which to each other measures the speed of the train. From results given by this instrument a very instructive curve was drawn, showing the manner in which a train comes to rest. Experiments were made on a piece of level line on the Midland Railway, between Nottingham and Newark. On a calm day a train weighing 125 tons, and moving at the rate of 45 miles an hour, ran 5 miles and 5 yards after the steam was shut off.

SOCIETIES AND ACADEMIES

London

Entomological Society, August 2.—Mr. F. D. Godman, M.A., F.R.S., vice-president, in the chair.—One new Member was elected.—Exhibitions : *Macropis labiata*, by Mr. F. Enock ; *Paragus tibialis* and *Discomyza incurva*, by Mr. T. R. Billups ; *Cicindela*, sp. from Babylon, by Miss E. A. Ormerod ; *Xyleborus saxesenii* (destructive to ale-casks sent out to Rangoon), by Mr. W. L. Distant.—Papers read : Notes on the life-history of *Sitones lineatus*, by Mr. T. H. Hart, read by Miss Ormerod.—On a visit to Ceylon, and the relation of Ceylonese beetles to the vegetation there, by Mr. G. Lewis, who had captured about 1200 species of beetles in Ceylon in five months.—On certain temperature forms of Japanese butterflies, by Mr. H. Pryer.

Paris

Academy of Sciences, August 21.—M. Boussingault in the chair.—The following papers were read :—On longitudinal shock of a free elastic bar against an elastic bar of other matter or of another size, fixed at the end not struck ; consideration of the extreme case in which the striking bar is very rigid and very short, by M. de Saint-Venant.—On the vaso-motor effects produced by excitation of the peripheric segment of the lingual nerve, by M. Vulpian. This nerve seems to have a certain degree of recurrent sensibility, manifested on stimulating the peripheric segment of the cut nerve, by contraction of the vessels in the opposite half of the tongue.—On the appearance of manganese on the surface of rocks (continued), by M. Boussingault. This relates chiefly to the *Challenger* observations. The sea and rivers contain carbonic acid favouring the dissolution of insoluble carbonates. When, from any cause, the acid gas is expelled, the salts are precipitated ; the carbonates of protoxide of iron and protoxide of manganese, once in contact either with the oxygen of the air, or with that dissolved in the water, are modified by sur-oxidation of their bases ; the carbonate of iron produces a red sesquinoxide, the carbonate of manganese a black oxide.—Some observations on the phylloxeras of Savoy, by M. Lichtenstein. The multiplication is very much less in Savoy and other regions, where the temperature is below 20° to 25° in summer. Seven species of phylloxera are now distinguished in France. — Observations at Marseilles Observatory, by M. Borrelly.—On the solar metallic eruptions observed at Rome during the first half of 1882, by P. Tacchini. Forty-three were observed, twenty-four north of the solar equator, and nineteen south. A maximum occurred in March. The number of lines was always small, and the solar activity was far from that of the preceding epoch of maximum. The line B*c* was the most frequent. The only splendid eruption was on June 21 ; its maximum height was about 167″. The maxima of the eruptions were between ± 10° and ± 20°, nearly as with the spots ; but they extended to greater latitudes.—Broadening of the spectral lines of hydrogen, by M. Van Monckhoven. He concludes from experiments that the broadening is quite independent of temperature, and solely due to pressure.—On the longitudinal shock of an elastic rod fixed by one of its extremities, by MM. Sébert and Hugoniot.—On approximate quadratures and cubatures, by M. Mansion.—Hydrodynamic experiments ; imitation by liquid or gaseous currents of stratifications of the electric light in rarefied gases and of various forms of the electric spark (seventh note), by M. Decharme. He moves horizontally and quickly over a plate covered with minium, a tube with issuing current of liquid or air.—Remarks on the subject of M. Tommasi's communication on the numerical relations between thermal data, by M. Le Blanc.—On a synthetic type of Annelid (*Anoplonereis Hermanni*) commensal of *Balanoglossus*, by M. Giard.—The quaternary formation of Billancourt, by M. Riviere.—Chemical composition of the banana at different degrees of maturation, by M. Ricciardi. The green banana contains about half of its weight of starch, which disappears in the ripe fruit, and the sugar in the fruits ripened on the plant is almost entirely cane sugar ; that of the fruits ripened after gathering, four-fifths inverted sugar, the rest cane sugar. The tannic substances and organic acids of the green fruits disappear in the ripe fruits. M. Ricciardi considers the CO_2 produced by the banana in the third period of its maturation is not due to alcoholic fermentation.—On modifications of the epidermic structure of leaves under various influences, by M. Mer.—Observations on an earthquake at Couchey (Côte d'Or), by M. Guillemot. This occurred at 4.25 a.m., on August 14 ; a single dull shock was followed by an oscillation south-south-east to north-north-west, lasting half a second. The shock was felt over at least 14 kilometres.

August 28.—M. Wurtz in the chair.—M. Mouchez communicated an address he had given at the inauguration of a statue to Fermat at Beaumont-de-Lomagne.—Meridian observations of small planets and of the comet Wells, at Paris Observatory, during the second quarter of 1882, by M. Mouchez.—On the inclination of the magnetic needle, by M. d'Abbadie. His observations with an inclination-needle of MM. Brunner, only 0·063m. long, prove its accuracy.—Communication on black phosphorus, by M. Thenard. As against doubts of the existence of black phosphorus, he states that lately, when moulding phosphorus in the usual way, and after getting a dozen rods, all of the ordinary colour, the thirteenth blackened suddenly throughout at the moment of cooling. The phenomenon was afterwards reproduced in a partial way.—Separation of gallium (continued), by M. Lecoq de Boisbaudran.—A communication by M. Chevreul affords evidence that Joseph Hubert, the friend and successor of Poivre in the island of Reunion, recognised, as early as 1788 (some ten years before English and German *savants*), the gyratory character of cyclones. In 1818 Hubert got the complete and correct formula expressing their double motion of gyration and translation (several years before Dove).—Observations of planets 227 and 229 with the western equatorial of the garden of Paris Observatory, by MM. Henry.—Solution of the problem of Kepler for considerable eccentricities, by M. Zenger.—On the formation of secondary couples with plates of lead, by M. Planté. He accelerates the formation of the couples, by first keeping them immersed twenty-four hours in nitric acid diluted one-half of its volume with water. The porosity produced extends the chemical action, which occurs on alternation of the primary current. These couples, in eight days, and after three or four changes of direction of the primary, yield results which were formerly obtainable only after several months' treatment.—M. Larroque presented a note on the transport, by lightning, of ferruginous particles contained in dust of the air. To this he attributes the persistence of the magnetic property observed in certain trees.

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