THURSDAY, JUNE 2, 1870

WHENCE COME METEORITES?

M. STANISLAS MEUNIER, the *collaborateur* of M. Daubrée, at the *Jardin des Plantes*, has worked with much assiduity during the past two years at the analysis of certain of the meteorites contained in the now important collection of these bodies in Paris; and in a recent number of this journal an account was given of a view propounded in *Cosmos* by M. Meunier as an answer to the question, Whence come Meteorites?

Whether M. Meunier's theoretical conclusions are to be looked on with the same favour that we heartily accord to his practical work is what we are about to discuss.

Briefly stated, his view is, that the character of the meteorites that fall on the earth has, during the short period embraced by human history, undergone a change. He supposes that formerly—by what he deems to have been a providential arrangement for the supply of metallic iron to our earliest ancestors, ere metallurgy had become an art—the meteorites that fell were of iron. Subsequently, and in our own particular age, stony meteorites have been descending to us of what M. Meunier terms the *type commun*. We may, perhaps, more accurately describe them as fine grained mixed rocks often presenting spherular structure, and consisting of magnesian and ferro-magnesian silicates, associated with small quantities of augitic and felspathic minerals, nickeliferous iron, and ferrous monosulphide (troilite), the last two sporadically disseminated in variable amounts.

These, then, are the meteorites that are falling now. Already M. Meunier thinks he sees the beginning of a new order of meteoric falls, though he does not give a single fact to show that such is the case, in the occasional visit to our earth of what he calls "the lavas" of the type of the meteorite of Stannern (which fell 22nd May, 1808), and of the carbonaceous meteorites, like that of Cold Bokkveldt (of 13th October, 1838). The former of these two very dissimilar kinds of meteorites consists, we may state, chiefly of a mixture of augite and anorthite, with a scarcely discernible amount of nickel-iron; in the latter kind graphite and solid hydro-carbon, strange to say, are met with, mixed with enstatite or olivine. These M. Meunier tells us are to be the meteorites of the immediate future. We fail, however, to see that these are less our contemporaries than are those of the *type commun*, except, indeed, that there are fewer of them. After they have had their day, our children may begin to look out for granitoid rocks, and perhaps even for portions of stratified deposits; and if we are disposed to ask "What next?" we must push M. Meunier's hypothesis to the logical conclusion his modesty seems to shrink from, and leave it to our remoter descendants to search diligently among the meteoric falls of their time for the fossil relics of organisms that may once have flourished on a now demolished world—providentially, let us suppose, reserved till those latter days, that they may reveal the answer to that keenly debated problem which Sir David Brewster linked with the hopes of the philosopher and the faith of the Christian!

For M. Meunier supposes meteorites to be the shattered morsels of a satellite smaller than and perhaps subordinated to the moon, which has run its course and been broken up by those internal throes of volcano and earthquake that form the true "defectus solis varios lunæque labores" which are in turn, according to M. Meunier, to break up Moon, and Earth, and Sun himself.

The fragments of this satellite he believes to be now careering in every direction, retrograde as well as direct, around our world, and gradually falling into its surface; the iron masses, as possessing the greatest specific gravity, having already descended; the rest following and to follow in the order of their densities. Certainly, we may observe, *in limine*, that this satellite must have been a very minute one, or its metallic ingredient in very small proportion to its other materials, if the iron meteorites that have reached the earth in historic times represent in any considerable proportion the amount of that ingredient. And it is not very easy to see what is to bring to the earth masses of matter, however small, moving in orbits round it, unless it be the retardation caused by their coming into contact with its atmosphere; an influence that would of course act in precisely the inverse manner to that assumed by M. Meunier, as the masses of lowest specific gravity would be the first to succumb to it.

But what are M. Meunier's grounds for this hypothesis? Does he explain anomalies in the moon's motion by it? Or does he rest it on what would certainly be at least a plausible ground for linking the meteorites by some close bond of attraction and direction of motion with the earth—on the fact, namely, that over one region in India, near to the greatest mountain protuberance on our globe, the recorded falls of meteorites are more numerous than on any other spot? a fact, however, that we believe has an altogether different explanation. M. Meunier does not even hint at such arguments as these. He goes to tradition, to a fragment of Æschylus, and to such comparatively modern evidence as that of an Icelandic Saga. In the former allusion is made to the well-known stone-strewn plain of the Crau, north-west of Marseilles, which according to the ancient myth was the scene of the contest between Hercules and the Ligures, when Zeus rained down a shower of stones to aid the hero. Now, if a myth venerable four centuries before Christ has any bearing on the question, this passage would certainly seem to hint that the *grêle de galets*, which M. Meunier quotes from Bouillet's translations (in the original it is νιφὰς στρογγύλων πέτρων), records a familiarity in those ancient days with falls of stones rather than of masses of iron, and certainly the quotation M. Meunier gives from a translation of the Edda might embody an allusion at least as happily to the aurora or to an eruption of Hecla as to a fall of meteorites. M. Meunier does not allude to the meteorite of Troy or of Ægospotamos or to the image of the Ephesian Artemis; and these were surely stones. So was the meteorite of Emesa, and if it be meteoric, such must be that other venerable fetish the Caaba stone. We need not perhaps discuss M. Meunier's wonderful attempt to connect by etymology the Latin *sidus* with the Greek σίδηρος, if this is what he implies by saying that σίδηρος had the double meaning of a star and of iron. But dismissing these cloudy reasonings, we may consider two other arguments brought forward by M. Meunier. One of these consists in the paucity of the number of iron meteorites that have been seen to fall as compared with that of stones of which the falls were witnessed: the proportion being only about 4 or 5 per cent. Thus in the collection at the British Museum we have 106 specimens of iron (siderites and siderolites together) indubitably meteoric, of which four only were seen to fall, while there are 179 of meteoric stones, of which only five have *not* been seen to fall. Surely, however, we have a sufficient explanation of this in the nature of the bodies themselves. The one, a mass of solid iron, besides possessing far greater permanence than a soft and porous rock permeated by small particles of readily rusting metal, would, if lying on the ground, be at once recognised by any one familiar with the metal, and would be preserved for use or as a curiosity; while the meteoric stone so found would equally naturally be neglected, unless the finder knew a meteorite as well as M. Meunier. Hence the iron meteorite is both better preserved and more surely recognised; and hence though its fall is a far rarer event in nature than that of the meteoric stone, our collections are comparatively rich in iron meteorites. That the American Continent has furnished so many meteoric irons to our collections is, no doubt, due to the ignorance of the uses of iron on the part of the ancient inhabitants of that continent, and to the comparatively unpeopled nature of the country. It is in the United States, and scattered over the plains and valleys of Mexico, or lying unrusted under the clear dry air of the Cordilleras of the Andes, that most of these iron masses have been found. They afford an ocular proof that, though after a longer or shorter time such irons must sink into a shapeless mass of oxides, yet under favourable conditions they can and do last through long generations before this destructive process is consummated. Indeed, if they do not, what becomes of M. Meunier's main argument? And if they do, the anomaly of their coming into our collections, while the stones, the fall of which has not been witnessed, are absent, does not seem so inexplicable.

M. Meunier advances another argument in support of his theory founded on the similarity of composition of certain meteorites that he has examined, and in which he recognises what he terms a stratification of different recurring varieties.

Assuming the correctness of this statement, we fail to see its logical connection with his theory. It is no new fact in the mineralogy of meteorites, whether of stone or iron, that the same minerals and combinations recur in them, and that certain of them look like chips from the same block. It is on this very account that a community of origin for those belonging to each group of them, if not indeed for the whole of even these groups themselves, has been so long suspected. But is not this a community of origin that links them not only one with another, but probably also to other bodies in space, and that by a much further reaching chain than one which would bind them down only to our tiny orb and its satellite? Indeed, the very remarkable parallelism between their constituent elements and those which have been revealed by prismatic analysis as existing in activity on the surface of the sun, gives to this question of the origin of meteorites an interest of that expectant kind which holds us, as it were, listening for the announcement of what may be the next new discovery in solar physics—some fact that may illuminate as by electric light the whole solar system, and, clearing up the mystery that surrounds the comets, the zodiacal light, the solar corona, and even our aurora, may tell us why the "fiery tears of St. Lawrence" and other meteor showers do not descend on us as νιφάδες πέτρων, and even explain the source whence the meteorites do really come. We shall then be able better to decipher the characters in which the history of the meteorites is written, a history which assuredly is engraved, though in hieroglyphic language, on these messengers from space to our world. Expectation of this kind should surely invest our reasoning with the kind of caution which befits men who, feeling in the twilight after a "quest" of this kind, are conscious that they cannot be very far off from touching it in very truth, and, as it were, with their hands. We venture to think that M. Meunier has not, on this occasion, succeeded in attaining to the object of that quest.

N. S. MASKELYNE

WHAT IS ENERGY?

II.

In our first article it was shown that energy, or the power of doing work, is of two kinds, namely, energy due to actual motion, and that due to position. We ended by supposing that a stone shot vertically upwards had been caught at the summit of its flight and lodged on the top of a house; and this gave rise to the question, What has become of the energy of the stone? To answer this we must learn to regard energy, not as a *quality*, but rather as a *thing*.

The chemist has always taught us to regard quantity or mass of matter as unchangeable, so that amid the many bewildering transformations of form and quality which take place in the chemical world, we can always consult our balance with a certainty that *it* will not play us false. But now the physical philosopher steps in and tells us that energy is quite as unchangeable as mass, and that the conservation of both is equally complete There is, however, this difference between the two things —the same particle of matter will always retain the same mass, but it will not always retain the same energy. As a whole, energy is invariable, but it is always shifting about from particle to particle, and it is hence more difficult to grasp the conception of an invariability of energy than of an invariability of mass. For instance, the mass of our luminary always remains the same, but its energy is always getting less.

And now to return to our question,—What has become of the energy of the stone? Has this disappeared? Far from it; the energy with which the stone began its flight has no more disappeared from the universe of energy, than the coal, when we have burned it in our fire, disappears from the universe of matter. But this has taken place:—the energy has changed its form and become spent or has disappeared as energy of actual motion, in gaining for the stone a position of advantage with regard to the force of gravity.

If we study this particular instance more minutely, we shall see that during the upward flight of the stone its energy of actual motion becomes gradually changed into energy of position, while the reverse will take place during its downward flight, if we now suppose it dislodged from the top of the house. In this latter case the energy of position with which it begins its downward flight is gradually reconverted into energy of actual motion, until at last, when the stone reaches the ground, it has the same amount of velocity, and, therefore, of actual energy, which it had at first.

Let us now revert, for a moment, to the definition of energy, which means the power of doing work, and we shall see at once how we may gauge numerically the quantity of energy which the stone possesses, and in order to simplify matters, let us suppose that this stone weighs exactly one pound. If therefore, it has velocity enough to carry it up one foot, it may be said to have energy enough to do one unit of work, inasmuch as we have defined one pound raised one foot high to be one unit of work; and in like manner if it has velocity sufficient to carry it 16 feet high, it may be said to have an energy equivalent to 16 units of work or foot-pounds as those units are sometimes called. Now, if the stone be discharged upwards with an initial velocity of 32 feet per second, it will rise 16 feet high, and it has therefore an energy represented by 16. But if its initial velocity be 64 feet per second it will rise 64 feet high before it turns, and will therefore have energy represented by 64. Hence we see that by doubling the velocity the energy is quadrupled, and we might show that by tripling the velocity the energy is increased nine times. This is expressed in general terms by saying that the energy or quantity of work which a moving body can accomplish varies as the square of its velocity. This fact is well known to artillerymen, for a ball with a double velocity will penetrate much more than twice as far into an obstacle opposing its progress.

Let us now take the stone or pound-weight having an initial velocity of 64 feet per second, and consider the state of things at the precise moment when it is 48 feet high. It will at that moment have an actual velocity of 32 feet per second, which, as we have seen, will represent 16 units of work. But it started from the ground with 64 units of work in it: what therefore has become of the difference—or 48 units? Evidently it has disappeared as actual energy; but the stone, being 48 feet high, has an energy of position represented by 48 units; so that at this precise moment of its flight its actual energy (16), *plus* its energy of position (48), are together equal to the whole energy with which it started (64).

Here, then, we have no annihilation of energy, but merely the transformation of it from actual energy into that implied by position; nor have we any creation of energy when the stone is on its downward flight, but merely the re-transformation of the energy of position into the original form of actual energy.

We shall presently discuss what becomes of this actual energy after the stone has struck the ground; but, in the meantime, we would repeat our remark how intimate is the analogy between the physical and the social world. In both cases we have actual energy and energy of position, the only difference being that in the social world it is impossible to measure energy with exactness, while in the mechanical world we can gauge it with the utmost precision.

Proteus-like, this element energy is always changing its form; and hence arises the extreme difficulty of the subject, for we cannot easily retain a sufficient grasp of the ever-changing element to argue experimentally regarding it. All the varieties of physical energy may, however, be embraced under the two heads already mentioned, namely, energy of actual motion and of position. We have chosen the force of gravity, acting upon a stone shot up into the air, as our example; but there are other forces besides gravity. Thus, a watch newly wound up is in a condition of visible advantage with respect to the force of the main-spring; and as it continues to go it gradually loses this energy of position, converting it into energy of motion. A cross-bow bent is likewise in a position of advantage with respect to the spring of the bow; and when its bolt is discharged, this energy of position is converted into that of motion. Thus again, a meteor, a railway train, a mountain torrent, the wind, all represent energy of actual visible motion; while a head of water may be classed along with a stone at the top of a house as representing energy of position. The list which represents visible energy of motion and of position might be extended indefinitely; but we must remember that there are also invisible molecular motions, which do not the less exist because they are invisible.

One of the best known of these molecular energies is *radiant light and heat*—a species which can traverse space with the enormous velocity of 186,000 miles a second.

Although itself eminently silent and gentle in its action it is, nevertheless, the parent of most of the work which is done in the world, as we shall presently see when we proceed to another division of our subject. In the mean time we may state that radiant light and heat are supposed to consist of a certain undulatory motion traversing an etherial medium which pervades all space.

Now, when this radiant energy falls upon a substance, part of it is absorbed, and in the process of absorption is converted into *ordinary heat.* The undulatory motion which had previously traversed the thin ether of space has now become linked with gross palpable matter, and manifests itself in a motion which it produces in the particles of this matter. The violence of this rotatory or vortex-like motion will thus form a measure of the heat which the matter contains.

Another species of molecular energy consists of *electricity in motion.* When an electric current is moving along a wire, we have therein the progress of a power moving like light with enormous velocity, and, like light, silent in its operation. Silent, we say, if it meets with no resistance, but exceedingly formidable if it be opposed; for the awe-inspiring flash is not so much the electricity itself as the visible punishment which it has inflicted on the air for daring to impede its progress. Had there been a set of stout wires between the thunder-cloud and the earth, the fluid would have passed into the ground without disturbance.

The molecular energies which we have now described may be imagined to represent motion of some sort not perceived by the outward eye, but present nevertheless to the eye of the understanding, they may therefore be compared to the energy of a body in visible motion, or actual energy as we have termed it.

But we have also molecular energies which are more analogous to the energy of position of a stone at the top of a cliff.

For instance, two bodies near one another may be endowed with a species of energy of position due to *opposite electrical states*, in which case they have a tendency to rush together, just as a stone at the top of a cliff has a tendency to rush to the earth. If the two bodies be allowed to rush together this energy of position will be converted into that of visible motion, just as when the stone is allowed to drop from the cliff its energy of position is converted into that of visible motion.

There is finally a species of molecular energy caused by *chemical separation*. When we carry a stone to the top of a cliff, we violently separate two bodies that attract one another, and these two bodies are the earth and the stone. In like manner when we decompose carbonic acid gas into its constituents we violently separate two bodies that attract one another, and these are carbon and oxygen. When, therefore, we have obtained in a separate state two bodies, the atoms of which are prepared to rush together and combine with one another, we have at the same time obtained a kind of energy of molecular position analogous on the small scale to the energy of a stone resting upon the top of a house, or on the edge of a cliff on the large or cosmical scale.

BALFOUR STEWART

FORMS OF ANIMAL LIFE

Forms of Animal Life; being Outlines of Zoological Classification, based upon Anatomical Investigation, and illustrated by Descriptions of Specimens and of Figures. By George Rolleston, D.M., F.R.S., Linacre Professor of Anatomy and Physiology in the University of Oxford. (Oxford: Macmillan and Co., 1870; Clarendon Press Series.)

I.

THIS long-promised and hoped-for book has at last appeared, and we may say at once that it fully maintains the well-earned reputation of its learned author. It will probably be most useful to his own pupils, for whom it seems to have been originally designed; and to those students of Comparative Anatomy who teach as well as learn.

The work consist of three parts: first, an enumeration of the anatomical characters of each sub-kingdom and class, arranged in a descending order from Mammalia to Gregarinæ—a plan less useful in most respects than the reverse one which is now generally followed. Next comes a minute description of certain dissected specimens in the new Museum at Oxford; and lastly an explanation of twelve plates, most of them original, which together supply a tolerably detailed account of the anatomy of at least one specimen of almost every class. "The distinctive character of the book consists in its attempting so to combine the concrete facts of Zoötomy with the outlines of systematic classification, as to enable the student to put them for himself into their natural relations of foundation and superstructure. The foundation may be made wider, and the superstructure may have its outlines not only filled up, but even considerably altered by subsequent and more extensive labours; but the mutual relations of the one as foundation and of the other as superstructure, which this book particularly aims at illustrating, must always remain the same." (Preface, p. vi.) This is very true, and it would have been well if all systems of classification had been thus based on anatomical facts. We may even suggest that the mutual relation of the foundation and the superstructure would have been still more obvious if the anatomical had preceded the systematic parts of the present work.

We propose, however, to follow Professor Rolleston's order, and to discuss here the classification he adopts, reserving an account of the second and third parts for a future article.

The question whether a perfect Zoological classification would be merely, like a perfect Nosology, a convenient method of stating and remembering a number of concomitant variations, or whether it would represent real genealogical relations between the several groups of animals, is one which has acquired great importance since the facts adduced by Darwin and Wallace have given probability to a modified form of the old theory of evolution. Most German naturalists fully accept this hypothesis, and employ their skill in constructing genealogical trees of each class. Dr. Rolleston holds that acceptance or rejection of the modern theory of evolution will depend on the particular constitution of each mind to which it is presented: "but," he adds, "whether the general theory be accepted as a whole or not, it must be allowed that in the face on the one hand of our knowledge of the greatness of the unlikeness which may be compatible with specific identity, and on the other of our ignorance of the entirety of the geological record, the value of the special 'phylogenies' reaching far out of modern periods are [qy. is] likely to remain in the very highest degree arbitrary and problematical."

It must, however, be remembered that, apart from its truth, a scientific theory may be very valuable by the accumulation of facts and the clearing of conceptions, to which it leads. Judged by this standard, the Darwinian theory is abundantly justified, not only by the observations of its illustrious author himself, but by the mass of excellent work it has evoked from others, especially in Germany. Indeed, from the results already gained, we may almost rank the theory of Natural Selection on a level with the teleological views which led Harvey to his great discovery, or with the belief in ideal archetypes by which Goethe was led to discover the presence of a præmaxillary bone in man, the "vertebral" construction of the skull, and the true morphology of a flower.*

Again, Dr. Rolleston enumerates the many similes by which men have endeavoured to represent the system of nature, and prefers the comparison of the groups of animals to the islands of an archipelago. Most readers will probably find the metaphor of a tree with its branches more useful, especially if existing forms are regarded according to Prof. Flower's ingenious suggestion, as the transverse section of such a tree, cut off at the present stage of the world's history. But, after all, by far the most natural, convenient, and almost inevitable metaphor

* Die Descendenztheorie wird so eine neue Periode in der Geschichte der vergleichenden Anatomie beginnen. Sie wird sogar einen bedeutenderen Wendepunct bezeichnen als irgend eine Theorie in dieser Wissenschaft vorher vermocht hat, denn sie greift tiefer als alle jene, und es gibt kaum Einen Theil der Morphologie, der nicht auf's Innigste von ihr berührt würde. (Gegenbaur: Grundzüge der Vergl. Anat. 1870, p. 19.)

is that of a great nation of common descent, not divided by one of the subjects into the arbitrary "provinces" of a kingdom, or "classes" of an army, but falling naturally into "alliances" which are those of blood, "families" which depend on common parentage, and "orders" which are hereditary. Now it is a great point gained to know that, probably, at least, such natural and convenient language is no metaphor at all, but strictly and literally true.

Prof. Rolleston follows Gegenbaur in elevating *Echinodermata* to the rank of a primary division, and its various orders to classes; and also in including under the head *Vermes*, not only the *Rotifera* and *Helminthes*, which, as "Scolecida," form, with Echinodermata, Prof. Huxley's Annuloid group; but the *Annulata* as well, which have been associated with the Arthropod classes by all other naturalists since Cuvier (see the long and valuable note on pp. 152-157). On the other hand, *Tunicata* and *Polyzoa* are not also placed in the same heterogeneous crowd of "Würmer," but are retained in their probably more natural position among the Mollusks. Indeed, the classes included by Dr. Rolleston under Vertebrata, Arthropoda, Mollusca, Cœlenterata, and Protozoa, are almost precisely the same as those recognised by Prof. Huxley, and generally admitted in this country. The only variation is in re-admitting Radiolaria among Rhizopods, and making "Ctenophorae" (why not Ctenophora?) a separate class, instead of an order of Anthozoa.

The "characteristics of Vertebrata" are given with the fulness and accuracy which mark the author's work. The eight closely-printed pages devoted to this section may be advantageously compared with the very short, but masterly account of the same group in Prof. Huxley's "Introduction to the Classification of Animals." Indeed, we would advise all students to read thoroughly the latter work before beginning the one under review, which would then admirably fill up the details of the London professor's sketches. At p. xxxv., it is implied that the kidney of Amphibia and most fishes answers to the permanent one of other vertebrates; its homology with the Wolffian body is, however, rightly stated at p. lxiv. We would suggest that the terms "outer" and "inner," are better than "uppermost" and "lowermost," to denote the serous and mucous layers of the germinal membrane; and at p. xl. "ventral" should replace "anterior,"—a term which confuses by mixing up the relations of human anatomy with those of general zootomy. We are not surprised that Dr. Rolleston refuses to accept Hamatocrya as a natural group of Vertebrata; he follows Prof. Huxley's division into Branchiata and Abranchiata, and of the latter into Mammalia and Sauropsida. Anammiota is a better alternative name for Branchiata than Anallantoidea; not only for euphony, but because an allantois is certainly present to some extent in certain Ichthyopsida, while its development and importance in mammals is far less than in birds and reptiles. In describing the characters of Mammalia, we notice that the author endorses Prof. Huxley's revised opinion that the malleus, not the incus, represents the quadrate bone, although the opposite is stated at p. 25 of the second part; but he appears to regard the marsupial bones as part of the pelvis, and not as mere ossifications of the internal pillar of the abdominal ring. The orders of the vertebrate classes are adopted from those given in the "Introduction to Classification" before referred to. That most of these will receive general assent there can be little doubt; but with respect to the placental classification of Mammalia, we venture to suggest some objections. In the first place the structure of the uterus and placenta is not strictly an embryonic character, but belongs to the parent organs of generation, which, in other classes, are found to be of minor importance in classification. Then it is very difficult to get accurate information as to the condition of the placenta—opportunities for observing parturition are, of course, much less frequent than for studying almost any other process—so that it will be long before we have any facts as to whole groups of animals, *e.g.*, the Sirenia. Moreover, if here opportunity is fleeting, judgment would seem to be often difficult: thus the placentation of so common a mammal as the rat was completely misunderstood by an eminent naturalist, until his account was corrected by Prof. Rolleston's own dissections. Compared with the skeleton, the teeth, or even the brain, the placenta is a far less available criterion, and far more liable to misinterpretation. But even if this were not the case, a grave objection to the placental classification remains in the fact that it necessarily excludes all fossil forms, the study of which has been so well used as a help in tracing the affinities of living animals, and by none more than Prof. Huxley himself. Lastly, judging this system by the test of concomitant variation, it is surely sufficiently condemned by compelling together animals so different as Primates and Rodentia, Orycteropus and Simia, while it separates Hyrax from Rodents and Perissodactyla, to unite it with Carnivora. The better plan we conceive is that followed by Prof. Flower in his recent lectures, to place the several orders in as natural juxtaposition as may be, and to put placental characters on the same level only as those afforded by the brain or the extremities.

In the careful description of the Mollusca which follows, Dr. Rolleston does not divide the Gasteropoda into two classes; nor does he admit the constancy of the primary flexures of the intestine, which Professor Huxley has made an important criterion of all the Molluscous series. (See pp. 58, 68, and 235.) In the *Ascidia* this question of the intestinal flexure depends upon the view taken of their great branchial sac. Dr. Rolleston does not admit Prof. Huxley's theory of its being morphologically a pharynx, but with Mr. Hancock regards it "as homologous not with a dilated pharynx, but with the branchial cavity, and the inhalent aperture to represent not the mouth, but the inhalent syphon of the Lamellibranchiata" (p. 69). If this view be accepted, it unites the Molluscoidea more closely to the Mollusca proper, and is an additional argument against their association with Vermes. The remarkable observations of Kowalewsky and Kupffer on the resemblances to vertebrate structures in the larva of Phalusia are duly noted (pp. ci. ciii.) Dr. Rolleston says of the Arthropoda that they "have frequently been classed together with more or fewer of the Vermes in one subkingdom, that of the 'Annulosa;' and whilst by such highly organised forms as the marine *Polychæta* an approximation appears to be made to certain of the less specialised of the Crustacea; or even of the Myriopoda, or the larvæ of insects, amongst the air-breathing Arthropoda; the microscopic Rotifera connect the Vermes, to which Sub-kingdom they are to be referred, very closely to the Crustacea"* (p. cvii.)

Although Gegenbaur's union of the Polyzoa and Tunicata with Vermes is not adopted, Huxley's group of Scolecida is divided into the three classes—Nematelminthes, Rotifera, and Platyelminthes. The Annulata again are divided into Annulata proper and Gephyrea. Dr. Rolleston ranks the remarkable genus *Sagitta* under the Nematelminthes (p. cxxxvii.), again following Gegenbaur, instead of placing it in a class by itself, the Chætognatha of Huxley.

We would here venture to question the advantage of the practice so generally followed by zoologists of making a separate order or even class—which generally entails at least one new name—for every aberrant genus. If *Sagitta* cannot be ranked with Annulata or Vermes, it might well stand under its generic head, or as the representation of an isolated family. In the same way we would deal with Sir John Lubbock's genus *Pauropus*, in relation to the two orders of Myriopoda, with *Hyrax* among mammals, *Archæopteryx* among birds, and *Amphioxus* among fishes. It is in vain to try to make all our classes or orders "of equal value." When natural families have been defined and grouped around a typical genus, the ordinal arrangement should, to a great extent, depend upon the number of species and other points of practical convenience. We learn nothing more of the single animal *Amphioxus lanceolatus* by a special order or sub-class, variously named by each classifier, being framed for its reception. So again we do not see the necessity of marking the distinction of *Marsupiata* and *Monotremata* from other mammals by the invention of fresh names—names which in this case have been singularly inappropriate, since several placental mammals are "didelphous," and the word "ornithodelphia" implies that birds have a uterus, and conceals the sauroid rather than ornithic affinities of Monotremata.

The description given by Professor Rolleston of the Cœlenterata is somewhat meagre, but that of Echinodermata is remarkably full, and when read in conjunction with the descriptions of *Asterias* and *Pentactes* (pp. 141-158, and 223-229, Plate x.), constitutes a valuable monograph of this complicated and interesting group of animals. Here, however, as in many other parts of the book, a few rough diagrams like those in the "Introduction to Classification," and in Prof. Greene's admirable monograph of Cœlenterata, would have been exceedingly useful, especially in explaining the more difficult points of embryology.

In treating of the Protozoa, with which the Infusoria are, we think, rightly associated, Professor Rolleston introduces a valuable disquisition upon the limits of the animal and vegetable kingdoms with the admission that "it is not rarely difficult to differentiate a unicellular organism as animal or vegetable, unless we happen to be acquainted with its past or future history" (p. clxii.). He does not admit Häckel's intermediate kingdom Protista, agreeing with almost all English naturalists in regarding *Monera* and *Protoplasta* as allied to Rhizopoda, and *Myxomycetæ* and *Flagellata* as vegetable organisms. He justly regards the chief difficulty to lie in the establishment of such statements as that animalcules as high as *Actinophrys* have at one period undoubtedly vegetable characters; but at the utmost the indeterminate groups would include very few of the organisms claimed by Prof. Häckel for his new kingdom.

In addition to the criteria usually given between animals and vegetables, it would seem that in all cases of true ovulation, the animal embryo absorbs its yelk from inside, while that of a seed is itself surrounded by the albumen; if this difference proves to be universal, it would be a remarkable foreshadowing of the mode of nourishment of adult animals and plants respectively.

* This sentence is a fair specimen of the author's compressed and parenthetical style, which sometimes reminds the reader of Lord Bacon and sometimes of S. Paul. A large insertion of brackets and dashes, of which there is scarcely one throughout the book, would often make plain the difficulties of a Thucydidean sentence, but even then only persons of great vital capacity could read the book aloud.

OUR BOOK SHELF

The Handy Book of Bees, being a Practical Treatise on their Profitable Management. By A. Pettigrew. (William Blackwood and Sons, Edinburgh and London.)

THIS book will be invaluable to the beginner in bee-keeping, and will probably contain many useful hints to the more experienced. The author is one of a family of beekeepers, who have always made a large profit from their bees. He is eminently practical, and the greater part of the work consists of careful notes on the various details of successful bee management. In the descriptive parts he is also very good, but is not quite so successful when he comes to treat of some disputed points in the economy of bees. For example, he maintains the theory that the eggs of bees are of no sex, and can be made into queens, workers, or drones, as the wants of the community render necessary. In this he is opposed to all the great authorities who have studied bees; and he even gives a series of letters from Mr. Woodbury, of Exeter, on the question, which are almost conclusive as to eggs being of two sorts when laid, one producing drones only, and not capable by any subsequent treatment of producing anything else; the other capable of producing workers or queens, according to the treatment they receive. His arguments against this view are of the weakest, and he suggests an experiment, which, he says, "is within the reach of very inexperienced persons," and which would completely settle the question; and yet he writes a book in which he brings up the subject, and opposes the best authorities, without having first taken the trouble to make the experiment himself! Again, he states positively that worker-bees live nine months only—never more; yet he gives no account of how this can be ascertained, or refers to the variety of opinion that exists as to their longevity.

As an example of the valuable matter in the practical part of the work, we quote his recipe for fumigation. "A few puffs of smoke from a bit of corduroy or fustian rolled up like a candle, stupefies and terrifies bees so much that they run to escape from its power. Tobacco smoke is more powerful still, but it has a tendency to make bees dizzy, and reel like a drunken man; besides, it is far more expensive, and less handy. Old corduroy or fustian is better than new, unless the matter used to stiffen it be completely washed out. The stiffening matter won't burn. The old worn-out and castaway fustian and corduroy clothes of labouring men cannot be surpassed for the purpose of stupefying bees. Let me ask the most timid bee-keeper in the country to try it. Get a piece the size of a man's hand, rolled up rather tight, and fired at one end—not to blaze, but simply to smoke. Let him now place the smoking end so close to the door of a hive that all the smoke may go in when he blows on it. After six or eight puffs have been sent into the hive, let him lift it off the board, turn it gently over upside down, so that the bees and combs stare him in the face.

By holding and moving the smoking ends of the rags over the face of the bees and blowing the smoke among them, they run helter skelter down amongst the combs far more afraid than hurt. Now he can carry the hive round the garden under his arm without being stung. Whenever the bees are likely to rise they should be dosed again. The bee-keeper will now find he has got the mastery over his bees, and can do what he likes with them. He will be able to drive them out of a hive full of combs into an empty one, and moreover shake them back, or tumble them back, or spoonful them back into the old hive or another, as men take peas from one basket to another. The smoke does not injure the health of the bees, does not stop them from work more than two or three minutes, and the use of it is so simple, easy, and efficacious, that we have no wish to find anything better for stupefying bees."

Hives, their material, size and position; their covers, boards, supers, ekes and nadirs; the times and modes of swarming bees artificially; how to feed them, and how to take the honey; how to combine separate hives, and how best to preserve them during winter, with many other details of bee-management, will be found so fully and clearly described, and with such good reasons for every step, that we think this work may do much to render profitable beekeeping far more common than it seems to be at present. A. R. WALLACE

Malacologia del Mar Rosso. Arturo Issel. 8vo. With five lithographed plates. (Pisa, 1869.)

WE have lately read and heard much about that great undertaking, the Suez Canal, and of its being the means of facilitating the commerce of the human race in Europe and India. Something may also be said as to the interchange of the marine fauna of the Mediterranean and Red Sea, which will probably result from this artificial mode of communication. Geology teaches us that these two seas were once (in the post-tertiary or quaternary period) connected by a natural channel; for several species of shells now inhabiting the Mediterranean, and common there, occur in a fossil state throughout the Isthmus or Desert of Suez. These are:—*Arca Noæ*, *A. lactea*, var. *erythræa*, *Donax trunculus*, *Solecurtus strigilatus*, *Gastrochæna dubia*, *Patella cærulea*, *Calyptræa Chinensis*, *Nassa mutabilis*, *N. costulata*, *Murex trunculus*, var., and *Cypræa annulus*. Now it is a remarkable fact that scarcely any species in a living state are common to the Mediterranean and the Red Sea, even after making every allowance for the range of local variation. Dr. R. A. Philippi, indeed, in the second volume of his admirable work on the Mollusca of the Two Sicilies (published in 1844), gave a list of all the marine shells which he had examined in the collection made by Hemprich and Ehrenberg in the Red Sea; and of these he identified no less than 75 species as living both in the Mediterranean and the Red Sea. According to him the number of Red Sea species found by Hemprich and Ehrenberg was 408. But it now appears that these explorers collected at Alexandria also on their way home, and that by some carelessness or mischance many of the labels indicating the localities got intermixed; so that no reliance could be placed on the collection in a geographical point of view when it was examined by Philippi.

The present work gives 574 recent or living species, of which 64 are for the first time described and 34 figured. As might be expected, nearly all are tropical and belong to the Indian Ocean. Besides these, 232 fossil species are enumerated, 25 being described as new to science, and 31 figured. The author collected 191 species on the shore at Suez in the spring of 1865; 141 were collected by the Marquis G. M. Arconati in the Gulf of Akaba, as well as at Suez; public museums and private cabinets at Berlin, Paris, Pisa, Turin, and Genoa furnished additional material; while the catalogues of Ehrenberg, Rüppel, and Vaillant, with the descriptions and plates of Philippi, Reeve, Sowerby, Kiener, and others, served for comparison and reference. Professor Issel is again gone to Suez for the purpose of continuing this interesting and useful research. His figures are very good, drawn on tinted paper. All general conchologists ought to possess the work.

I may remark that one of the Red Sea species (*Cæcum annulatum*) here stated to inhabit "Aden, Indie occidentali, Irlanda, Inghilterra"—the last two localities being, on the authority of Brown, Forbes and Hanley, and Philip Carpenter—has been only found in Great Britain among the sand from bath-sponges!

It should be known that Mr. M'Andrew dredged for several months last year in the Gulf of Suez, when he made a very extensive collection of Mollusca, including a great number of then undescribed species. I hope he will soon publish his discoveries. No one is more competent to do so.

J. GWYN JEFFREYS

LETTERS TO THE EDITOR

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

The New Natural History Museum

I AM informed that the plan of fitting a museum with cases sealed on the side facing the public galleries, alluded to in last week's NATURE, was suggested by Dr. Hooker, in an article signed "A Metropolitan Naturalist," in the *Gardener's Chronicle* for 1858, p. 749, which also contains many other good suggestions as to the requirements of the museum.

W. H. FLOWER

The "English Cyclopædia"

IN my youth I took in "The Penny Cyclopædia," in my manhood I purchased its progeny, "The English Cyclopædia," and now, in comparative old age, I have acquired two supplementary volumes to the latter; and I have never had reason to complain of any of these books, until the supplement to the Natural History division appeared a month or two ago. This supplement embraces a period of sixteen years, from 1854 to 1870, during which, probably, more good scientific work has been accomplished than in any preceding half-century. Many subjects on which I expected to find important articles are passed over without a reference, and others are, as I shall endeavour to show, treated of in a most imperfect and unsatisfactory manner.

I looked in vain for articles on (1) *Acclimatisation*, (2) *Ants*, (on which Bates, Lespes, Lincecum, Norton, F. Smith, Sumichrast, and many others have written since 1854), (3) *Axolotl* (whose remarkable metamorphoses have been studied by Dumeril and others), (4) *Cephalopoda* (on which much has been written since the Cyclopædia article appeared, when the Hectocotylus had not become a subject of discussion), (5) *Darwinism*, (6) *Deep-sea Dredging*, (7) *Dimorphism in the Animal Kingdom*, (8) *Eophyton*, (9) *Eozoon*, (10) *Eugerion* (a fossil insect that from its puzzling form has been compared with the Archæopteryx), (11) *Fungous Origin of Diseases*, the cholera-fungus, scarlatina-fungus, ague-fungus, the fungi in skin-diseases, &c., and (12) *Hyalonema* (on which several articles holding the most opposite views have lately appeared); (13) *Hybridity in animals and plants* (on which Broca, Masters and others have written elaborate works, and on which, as in the case of rabbits and hares, many remarkable experiments have been made), (14) *Mimicry in the Animal Kingdom*, (15) *Monera*, (16) *Ornithoscelida*, (17) *Parthenogenesis* (on which, during the last sixteen years, there have been published Siebold's "True Parthenogenesis in Lepidoptera and Bees," Owen "On Parthenogenesis," Leuckart "On the recognition of Parthenogenesis in Insects," De Quatrefages' "Metamorphoses of Man and the lower Animals," and the contributions of Huxley and Lubbock to Transactions of the Linnean Society and to the Philosophical

Transactions, besides numerous articles on special cases of Parthenogenesis in certain gall-flies, solitary wasps, spiders, and mites), (18) *Protista*, (19) *Protoplasm*, (20) *Rhizocrinus*, which sent forth our late deep-sea dredging expeditions, (21) *Sauroids* and *Sauropsida*, (22) *Sphegidæ* (insects whose marvellous instincts have been described by Lespes and other observers), and (23) *Vivisection* and its results.

A few of these subjects are discussed in articles devoted to more general matters; for example, (8) is noticed, but not figured or even systematically described, under *Foraminifera*, *Laurentian Formations*, and *Palæontology*, and (9) is referred to in the last-named article; (12) is mentioned in *Spongiadæ*, and more fully described, but not figured, in *Alcyonaria*; (17) is alluded to, in so far as the researches of Huxley and Lubbock go, in the article *Aphis*; (19) is noticed under *Cells*; and (21) *Sauropsida* is defined in the article on *Birds*.

Cross references, which, like illustrations, have been far too scantily employed in these volumes, would have partly removed this source of complaint, as for example *Sauropsida* [Birds, E.C.S.]

On the following subjects our knowledge has not been brought up to what can with every allowance, be called a recent date:—(1) *Aerolites*, latest reference 1861, and no bibliography; (2) *Alca*, latest reference 1861; (3) *Annelida* contains no reference to Claparède's appalling criticism on De Quatrefages' researches; (4) *Archæopteryx* has no reference to Huxley's papers; (4) *Blood* contains no reference to late researches on the structure of the corpuscles, to the occurrence of *Protagon* in them, or to the remarkable colour-test for blood, discovered by Dr. Day of Geelong, which has succeeded in detecting old blood spots, when even spectrum analysis in the hands of its great master, Mr. Sorby, has failed; and Dr. Richardson is stated to hold the opinion that the fibrin is held in solution in the body by ammonia, although it is well known that, with a moral courage which cannot be sufficiently commended, he publicly (at a meeting of the British Association some years ago) renounced that opinion as soon as he found it was untenable; (5) *Birds of Paradise* would have been a more satisfactory article if it had had the benefit of Mr. Wallace's supervision; (6) *Foraminifera* would have been all the better if the writer had been acquainted with Häckel's splendid monograph on the *Radiolaria*; (7) *Nervous System* is perhaps the most imperfect article in the whole volume. It contains no reference to the labours of Gratiolet, Lockart Clarke, Brown-Sequard, Claude Bernard, Robin, Philippeaux, or Vulpian on the minute structure and the physiology of the nerves, while the chemistry of the brain is discussed without a reference to Protagon or Neurine. The synthetical formation of the latter is surely of sufficient interest to deserve notice.

Regard for the value of space in your columns alone prevents me from prolonging the list of imperfect articles.

The English Cyclopædia is, as I presume everyone will admit, intended for "all sorts and conditions of men," for "women labouring with child" (if we use the phrase in the same sense as a German governess, who is said to have expatiated to a popular bishop on the comprehensiveness of a church-service that did not even overlook the daily cares of those who devoted themselves to the duties of early education), and even for children; at all events I read the "Penny" with great pleasure as a boy. Hence it should be a source of knowledge from which we might expect to find information in all cases of ordinary difficulty. To decide how far this assumption is correct, I put it to the test in the following way:—I read Huxley's splendid address "On the recent progress of Palæontology" which lately appeared in your columns, and the "Report on a Close Time for Birds" in the last volume of the British Association Reports. I freely admit that I am not learned in Natural History; but as an old country doctor, I probably picked up quite as much knowledge in my youth, as the average class of "Cyclopædia" readers. None of the following terms taken from Huxley's address are to be found either in the Index to the Cyclopædia, or in the Supplement:—*Amphycion*, *Anchitherium*, *Anthracosaurus*, *Artiodactyle*, *Cainotherium*, *Chœropotamus*, *Coccoliths*, *Coccospheres*, *Compsognathus*, *Coryphodon*, *Dicynodes*, *Didelphia*, *Dinosauria*, *Discoliths*, *Elasmobranchs*, *Eophyton*, *Eozoon*, *Evolution*, *Galeosaurus*, *Globigerinæ*, *Hipparion*, *Hipparitherium*, *Homotaxis*, *Hyænictis*, *Hyenoartos*, *Hyopotamus*, *Hyracotherium*, *Ictitherium*, *Mesopithecus*, *Microlestes*, *Monadelphia*, *Omalodotherium*, *Ornithodelphia*, *Ornithoscelida*, *Orycteropus*, *Perissodactyle*, *Phaseolotherium*, *Pliolophus*, *Pterosauria*, *Sauropsida*, *Stereognathus*, *Typotherium*.

I will not go further into the "Close Time" Report than to state that I learn from it the important fact that owls eat, *inter alia*, "*Arvicolæ*, *Crociduræ*, *Crossopi*, *Hypudæi*, *Sorices*, shrews and voles." I look in vain for all these inviting edibles, and I find only *Hypudæus* in the Cyclopædia, and what benefit do I derive from my search? Only that *Hypudæus* is sometimes spelt *Hipudæus*. A learned friend, who is ever ready and able to remove difficulties from the paths of his weaker brethren—the genial guardian of Kent's Cavern—suggested that it was something in the mouse or rat line, and so I turned to *Muridæ*, where I found the required information regarding that animal and the voles.

It is not for the purpose of depreciating the Supplement to the English Cyclopædia that I have noticed the above omissions and deficiencies, but with the object of pointing out how they may still be remedied. The Supplement has evidently been drawn up without any editorial care. Let a duly-qualified editor obtain a list of *desiderata* from some botanist, geologist, and zoologist of eminence; and let him fix upon the articles that he deems the most important, and give them to qualified writers. Let him attend duly to the compilation of bibliographies of the most important subjects, and let him increase to an enormous extent the amount of cross references. The article *Muridæ*, from which I exhumed *Hypudæus*, would probably yield fifty references.

A few subjects—as birds and hydrozoa—are fairly supplemented. Why should not similar articles be given us on the progress, during the last sixteen years, of our knowledge of the crustaceans, insects, fishes, reptiles, &c.? An additional supplement, such as I have here suggested, would probably not occupy more than 100 pages.

NEMO

South Devon

ADMIRAL MANNERS

ADMIRAL RUSSELL HENRY MANNERS was born in London on the 31st of January, 1800, entered the Royal Naval College the 6th of May, 1813, and embarked March the 6th, 1816, as a volunteer on board the *Minden*, 74, Captain Paterson, in which, after assisting at the bombardment of Algiers, he proceeded to the East Indies, where he served under the flag of Sir Richard King, until nominated midshipman, the 1st of July, 1818, to the *Orlando*, 36, commanded by Captain John Clavell, with whom, in 1819, he returned to England on the *Malabar*, 74. After an intermediate employment on the Channel and West India stations in the *Spartan* and *Pyramus* frigates under Captains William Furlong Wise and Francis Newcombe, he became, the 29th of July, 1822, Acting Lieutenant of the *Tyne*, 26, Captain John Edward Walcot, to which vessel the Admiralty confirmed him the 19th of October following. In May 1823, he rejoined the *Pyramus*, still commanded by Captain Newcombe, under whom he continued until he obtained his promotion on the 16th of August, 1825. His last appointment was on the 21st of October, 1827, to the command of the *Britomart*, 10. The *Britomart* was first employed and intended for the Channel service under the order of the Commander-in-Chief, the Earl of Northesk, at Plymouth. She accompanied the squadron of ships escorting Don Miguel to Lisbon in the early part of 1828. In consequence of the revolution that followed in Portugal on Don Miguel declaring himself absolute, the *Britomart* was stationed at and off Oporto to watch the British interests there. The Constitutional party, failing to restore the Constitution against the usurped position of Don Miguel, the British Government withdrew her Minister from Lisbon, leaving the British interests in the hands of the Consul only, and Capt. Manners was selected to be in readiness to support him in case of need by keeping in sight of signals from Lisbon as long as the safety of the vessel permitted, but not to anchor within any Portuguese port unless absolutely necessary. This involved a long and vigilant cruising off and on the coast for about eight months, and through the whole of the winter. The only place communicated with during that time was Gibraltar, and then only to receive a supply of provisions and water from the dockyard. The yellow fever unfortunately breaking out at Gibraltar just before going there for this object, no communication could be had with the town, and the stay was confined to from twenty-four to forty-eight hours. The zeal and ability with which this service was carried out by Capt. Manners, as witnessed by Sir George Sartorius, there in command of the Portuguese Constitutional Squadron, and under whose orders in some degree the *Britomart* was placed, led to Capt Manners receiving his Post-rank on the 4th of March, 1829. He retired from active service in March 1849, became Rear-Admiral in July 1855, Vice-Admiral in April 1862, and Admiral in September 1865.

Admiral Manners was the only child of the late Mr. Russell Manners, M.P., and married in 1834 Louisa Jane, daughter of Count de Noé, Peer of France, who survives him, and by whom he has two sons and a daughter.

From the time he attained his Post-rank to the time of his death he devoted himself to scientific pursuits. He was elected a member of the Royal Astronomical Society in 1836. At a very early period he took an active interest in its administration, and after being on the Council for some time, was elected one of the honorary secretaries in February 1848, an office which he filled until 1858, when he accepted that of Foreign Secretary. This was a post for which his knowledge of foreign languages and his position in society peculiarly fitted him, and during his tenure of office he formed by active correspondence a connecting link between English and foreign astronomers. He was much esteemed abroad, so much so indeed that one of the presidents, in asking Admiral Manners to transmit one of the Society's medals to a foreign recipient, deemed it just to preface his remarks with the following well-deserved compliment :—

"Admiral Manners,—It has been my good fortune to visit the majority of European Observatories, and to make the acquaintance of their directors and other gentlemen connected with them, and it has in consequence become known to me how high in their esteem our Foreign Secretary stands. Your urbanity and promptitude in carrying out our foreign business has indeed become proverbial."

Admiral Manners was, on more than one occasion, asked to accept the chair of President, which, after some hesitation, he consented to do, and he was elected to that position in 1868. None of his predecessors was more highly esteemed by the Fellows of the Society, and no one filled the chair more admirably than he did. His mathematical attainments were considerable, more so than one might be apt to infer from his quiet demeanour. He was well versed in the astronomical literature of the day, and took a deep interest in the progress of astronomical science, both in England and on the Continent; and his active influence was always available for the promotion of any object connected with it.

On presenting the gold medal of the Society to Mr. Stone, first assistant of the Royal Observatory, Greenwich, Admiral Manners delivered a most able and exhaustive summary of that able astronomer's labours, and evinced a complete knowledge of the history of the solar parallax, for the investigation of which the medal was mainly awarded. Illness overtook him before he could complete his second year of office, and he was compelled to forego the gratification of delivering the address to M. Delaunay for his researches on the lunar theory; but he made it a point of duty and pleasure to receive M. Delaunay at his house, and although he was compelled to delegate to the friendly hand of Prof. Adams the drawing up of the address, yet he read and approved of what was written before it was delivered.

Admiral Manners in all his relations was a pure-minded, courteous, and sympathetic man, and in the fullest sense of the word a gentleman.

THE PRIMITIVE VEGETATION OF THE EARTH

TWENTY years ago scarcely anything was known, even to those engaged in the study of vegetable fossils, of a land flora older than the great coal-formation. In 1860, Goeppert, in his Memoir on the plants of the Silurian, Devonian, and Lower Carboniferous, mentions only one land plant, and this of doubtful character, in the Lower Devonian. In the Middle Devonian he knew but one species; in the Upper Devonian he enumerated fifty-seven. Most of these were European, but he included also such American species as were known to him. The paper of the writer on the Land Plants of Gaspé was published in 1859, but had not reached Goeppert at the time when his memoir was written. This, with some other descriptions of American Devonian plants not in his possession, might have added ten or twelve species, some of them Lower Devonian, to his list. In the ten years from 1860 to the present time, the writer has been able to raise the Devonian flora of Eastern North America to 121 species, and reckoning those of Europe at half that number, we now have at least 180 species of land plants from the Devonian, besides a few from the Upper Silurian. We thus have presented to our view a flora older than that of the Carboniferous period, and, in many respects, distinct from it; and in connection with which many interesting geological and botanical questions arise.

Geologists are aware that in passing backward in geological time from the modern to the Palæozoic period, we lose, as dominant members of the vegetable kingdom, first, the higher phænogamous plants, whether exogenous or endogenous; and that, in the Mesozoic period, the Acrogens, or higher cryptogams, represented by Ferns, Club-mosses, and Equiseta, share the world with the Gymnosperms, represented by the Pines and Cycads, while the higher phænogams on the one hand, and the lower cryptogams on the other, are excluded. Hence, the Mesozoic age has been called that of Gymnosperms, while the Palæozoic is that of Acrogens. These names are not, however, absolutely accurate, as we shall see that one of the highest forms of modern vegetation can be traced back into the Devonian; though the terms are undoubtedly useful, as indicating the prevalence of the types above mentioned, in a degree not now observed, and a corresponding rarity of those forms which constitute our prevalent modern vegetation.

It is my present object shortly to sketch the more recent facts of Devonian and Upper Silurian Botany, and to refer to a few of the general truths which they teach. The rocks called Devonian in Europe being on the horizon of the Erie division of the American geologists, which are much more fully developed than their representatives on the Eastern Continent, I shall use the term *Erian* as equivalent to Devonian, understanding by both that long and important geological age intervening between the close of the Upper Silurian and the beginning of the Carboniferous.

Just as in Europe the rocks of this period present a twofold aspect, being in some places of the character of a deposit of "Old Red Sandstone," and in others indicating deeper water, or more properly marine conditions, so in America, on a greater scale, they have two characters of development. In the great and typical *Erian* area, extending for 700 miles to the westward of the Apalachian chain of mountains, these rocks, sometimes attaining to a thickness of 15,000 feet, include extensive marine deposits; and except in their north-eastern border are not rich in fossil plants. In the smaller north-eastern area, on the other hand, lying to the eastward of the Apalachian range, they consist wholly of sandstones and shales, and are rich in plant remains while poor in marine fossils. Hence it is the Devonian of Gaspé, of New Brunswick, and of Maine, with that of eastern New York, which have chiefly afforded the plants to be described below; and it is exclusively in these areas that we find underclays with roots, or true fossil soils. Most of the localities of fossil plants in the districts above mentioned have been visited, and their plants studied *in situ* by the writer. The Gaspé sandstones were first studied and carefully measured and mapped by Sir W. E. Logan. The Devonian beds of St. John's, New Brunswick, have been thoroughly examined and illustrated by Prof. Hartt and Mr. Matthews, and those of Perry by Prof. Jackson, Prof. Rogers, and Mr. Hitchcock. Prof. Hall, of the Survey of New York, has kindly communicated to me the plants found in that State, and Prof. Newberry has contributed some facts and specimens illustrative of those of Ohio.

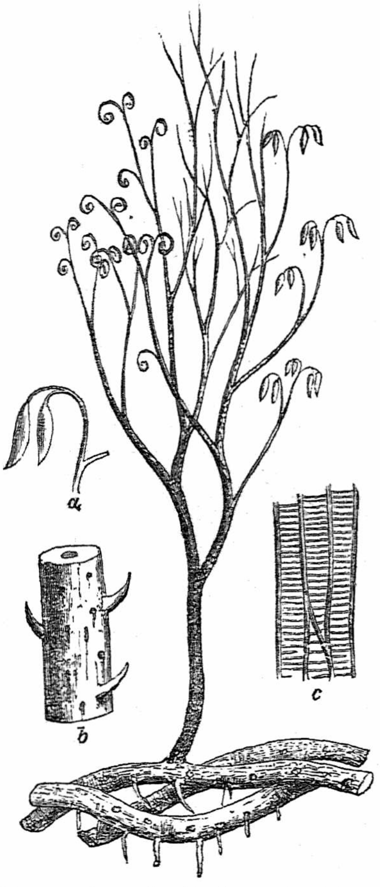

FIG. 1.—*Psilophyton princeps*—the oldest known plant of America, restored. (*a*), Fruit, natural size; (*b*), Stem, natural size; (*c*), Scalariform tissue of the axis, highly magnified. In the restoration one side is represented in vernation, and the other in fruit.

In the Sandstone cliffs of Gaspé Bay, Sir W. E. Logan recognised in 1843 the presence of great numbers of apparent roots in some of the shales and fine sandstones. These roots had evidently penetrated the beds in a living state, so that the root-beds were true fossil soils, which, after supporting vegetation, became submerged and covered with new beds of sediment. This must have occurred again and again in the process of the formation of the 4,000 feet of Gaspé sandstone. The true nature of the plants of these fossil soils I had subsequently good opportunities of investigating, and the most important results, in the discovery of the plants of my genus *Psilophyton*, are embodied in the restoration of *P. princeps* in Fig. 1. This remarkable plant, the oldest land plant known in America, since it extends through the Upper Silurian as well as the Devonian, presents a creeping horizontal rhizome or root-stock, from the upper side of which were given off slender branching stems, sometimes bearing rudimentary leaves, and crowned, when mature, with groups of gracefully nodding oval spore-cases. The root-stocks must in many cases have matted the soils in which they grew into a dense mass of vegetable matter, and in some places they accumulated to a sufficient extent to form layers of coaly matter, one of which on the south side of Gaspé Bay is as much as three inches in thickness, and is the oldest coal known in America. More usually the root-beds consist of hardened clay or fine sandstone filled with a complicated net-work or with parallel bands of rhizomes more or less flattened and in various states of preservation. In all probability these beds were originally swampy soils. From the surface of such a root-bed there arose into the air countless numbers of slender but somewhat woody stems, forming a dense mass of vegetation three or four feet in height. The stems, when young or barren, were more or less sparsely clothed with thick, short, pointed leaves, which, from the manner in which they penetrate the stone, must have been very rigid. At their extremities the stems were divided into slender branches, and these when young were curled in a crosier-like or circinate manner. When mature they bore at the ends of small branchlets pairs of oval sacs or spore-cases. The rhizomes when well preserved show minute markings, apparently indicating hairs or scales, and also round areoles with central spots, like those of Stigmaria, but

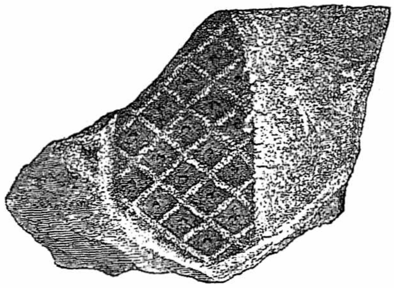

FIG. 2.—*Leptophleum rhombicum*—a Lycopodiaceous tree of the Devonian.

not regularly arranged. These curious plants are unlike anything in the actual world. I have compared their fructification with that of the Pilulariæ or Pillworts, a comparison which has also occurred to Dr. Hooker. On the other hand, this fructification is borne in a totally different manner from that of Pilularia, and in this respect rather resembles some ferns; and the young stems by themselves would be referred without hesitation to Lycopodiaceæ. In short, Psilophyton is a generalised plant, presenting characters not combined in the modern world, and, perhaps illustrating what seems to be a general law of creation, that in the earlier periods low forms assumed characteristics subsequently confined to higher grades of being.

A second species of Psilophyton (*P. robustius*), also abundant at Gaspé, shows stouter stems than the former, more abundantly branching and with smaller leaves, often quite rudimentary. Its spore-cases are also of different form and borne in dense clusters on the sides of the stem. Masses of very slender branching filaments appear to indicate a third species (*P. elegans*) which is also found in the Devonian of St. John, New Brunswick. These species of Psilophyton occur both in the lower and middle Devonian, and, as will be mentioned in the sequel, they extend also into the Upper Silurian.

Decorticated and flattened stems of Psilophyton cannot be readily recognised, and except when their internal structure has been preserved, might be mistaken for algæ, a mistake which I believe has in some instances been made. Specimens of the barren stems (*var. ornatum*) might readily be referred to the genius *Lycopodites*.

Another genus of generalised type is that named by Haughton *Cyclostigma*. As found at Gaspé it presents slender stems with rounded scars, placed either spirally or in transverse rows, and giving origin to long rigid leaves. It had a slender axis of scalariform vessels, and fructification of the form of elongated spikes or strobiles is found with it. In many respects these plants resembled Psilophyton, and their affinities were distinctly Lycopodiaceous. Specimens from Ireland, in the Museum of the Geological Society, kindly shown to me by Mr. Etheridge, appear to show that in that country these plants attained the dimensions of trees, and had roots of the nature of Stigmaria. Mr. Carruthers has even suggested that they may be allied to *Syringodendron*, a group of Carboniferous trees connected with the *Sigillariæ*.

The genus *Lycopodites* is represented by a trailing species, bearing numerous oval strobiles (*L. Richardsoni*), a species quite close to many modern club-mosses (*L. Matthewi*), and a remakable pinnate form (*L. Vanuxemii*), which, though provisionally placed here, has been variously conjectured to resemble Ferns, Cycads, Algæ, and Graptolites. But the most remarkable Lycopodiaceous plants are the gigantic arboreal *Lepidodendra*, plants

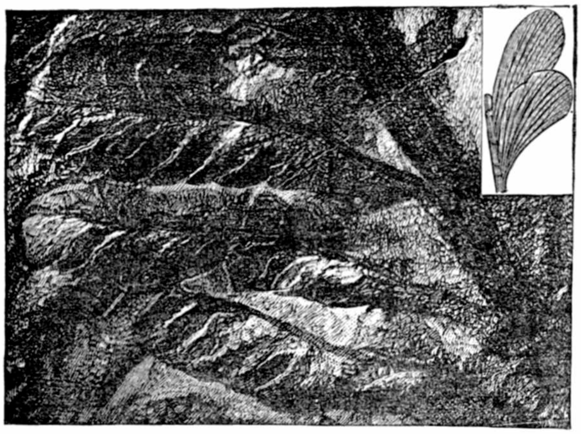

FIG. 3.—*Cyclopteris (Archæopteris) Jacksoni*—a Devonian Fern, the American representative of *C. Hibernicus*.

which, while they begin in the Middle Devonian, become eminently expanded in numbers and magnitude in the Carboniferous. The common species in Eastern America (*L. Gaspianum*) was of slender and delicate form, very elegant, but probably not of large size. In the same family I would place my new genus *Leptophleum*, a portion of whose curiously-marked bark is represented in Fig. 2.

The *Calamites*, afterwards so largely developed in the Carboniferous, and to be replaced by true Equiseta in the Trias, make their first appearance in a large species (*C. inornatum*) in the Lower Devonian, and are represented in the middle and upper parts of the system by two other species, which extend upward into the Carboniferous. They are also represented in the Devonian of Germany and of Devonshire. The peculiar type indicated by the internal casts known as *Calamodendron* is likewise found in the Devonian.

More beautiful plants were the *Asterophyllites*, with more slender and widely branching stems, and broader leaves borne in whorls upon their branches. These plants have been confounded with leaves of Calamites, from which, however, they differ in form and nervation, and in the want of the oblique interrupted lines common to the true leaves of Calamites and to the branchlets of Equisetum. The Asterophyllites, and with them a species of *Sphenophyllum*, appear in the Middle Devonian.

No plants of the modern world are more beautiful in point of foliage than the Ferns, and of these a great number of species occur in the Middle and Upper Devonian. I must refer for details to my more full memoirs on the subject, and in the present paper shall content myself with a few general statements. Some of the generic forms of the Devonian, and perhaps a few of the species, extend into the Carboniferous; others are peculiar to the Devonian; and among these, forms allied to the modern Hymenophyllum and Trichomanes appear to prevail. One remarkable type, *Cyclopteris (Archæopteris) Hibernicus*, with its American allies, *C. Jacksoni*, &c., extends in the Upper Devonian over both continents, yet is wanting in the Carboniferous. Tree ferns also existed in the Devonian. Two species have been found by Dr. Newberry in Ohio, and remarkable erect trunks have been obtained by Professor Hall from Gilboa, in the State of New York. The latter are surrounded by aerial roots, and thus belong to the genus *Psaronius;* a genus which, however, must be artificial, since in modern tree ferns aerial roots often clothe the lower part of the stems while absent from the upper part. The only indication as yet of a tree fern in the Old World is the *Caulopteris Peachii*, of Salter, from the Old Red of Scotland. It is further remarkable that the ferns of the genus Archæopteris are much more large and luxuriant in Ireland than in America, and that in both regions they characterise the upper member of the system.

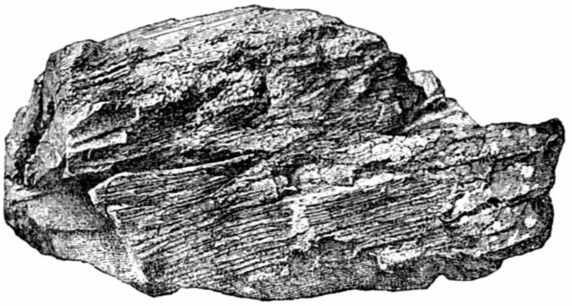

FIG. 4.—*Prototaxites Logani*—the oldest known tree. (Fragment of the trunk, much reduced.)

Of the plants of the Palæozoic world, none are more mysterious than those known to us by the name *Sigillariæ*, and distinguished by the arrangement of their leaves in vertical series, on stems and branches often ribbed longitudinally, and by the possession of those remarkable roots furnished with rootlets regularly articulated and spirally arranged, the Stigmariæ. It seems evident that this group of plants included numerous species, differing from each other both in form and structure. Still, as a whole, they present very characteristic forms dissimilar from those of their contemporaries, and still more unlike anything now living. I believe that many of them were Gymnosperms, or at the least, Acrogens with stems as complicated as those of Gymnosperms. In the Carboniferous period these plants have a close connection with the occurrence of coal. Nearly every bed of this mineral has under it a "Stigmaria underclay," which is a fossil soil on which a forest of Sigillariæ has grown, and the remains of these trees are very abundant in the coal and the accompanying beds. Hence the Sigillariæ of the coal-period are regarded as the plants most important in the accumulation of coal. In the Devonian, as far as we yet know, they did not attain to this utility, and in the lower part of the system at least, the rhizomata of Psilophyton seem to have occupied the place afterwards held by the Stigmariæ. In connection with this, it is to be remarked that the Sigillariæ of the Erian period seem to have been few, and of small dimensions in comparison with those of the coal.

Rising still higher in the vegetable kingdom, and arriving at unquestionable Gymnosperms, we find in the Devonian of Eastern America, and also, I believe, in that of Scotland and Germany, trunks which may be referred to Coniferæ. In the Middle and Upper Devonian these present the structure of modern Araucarian pines, or that modification of it belonging to the Carboniferous trees of the genus *Dadoxylon*. In the Lower Devonian we have what seems to be a simplification of the Coniferous structure, in the cylindrical wood-cells, marked only with spiral threads, found in the genus *Prototaxites*. These trees are very abundant as drift trunks in the Lower Devonian, down almost to its bottom beds, and sometimes attain to a diameter of three feet. Though of a structure so lax that it is comparable only with the youngest stems of ordinary Coniferæ, these trees must have been durable, and they are furnished both with medullary rays and rings of annual growth. Unfortunately we know nothing of their foliage or fruit. Fig. 4 represents a fragment of the wood of one of these trees, mineralised by infiltration of the tissues with silica, so that the structure is preserved.

But for one little fragment of wood, we should have had no indication of the existence in the Erian of any trees of higher organisation than the Conifers. This fragment, found by Professor Hall at Eighteen-mile Creek, Lake Erie, has the dotted vessels characteristic of ordinary Exogens, and unquestionably indicates a plant of the highest kind of organisation. Until confirmed by other facts, this discovery may be received with doubt, but I believe it can be relied on.

Our knowledge of the flora of the Upper Silurian is at present nearly in the same state with that of the Middle and Lower Devonian ten years ago. I know in the Upper Silurian of Canada but two species of *Psilophyton*, both apparently identical with Devonian forms. In England, besides the spore-cases known by the generic name *Pachytheca*, there exist in the collections of the Geological Survey fragments of wood and bark which I believe indicate two additional species. In Germany three or four species are known in rocks of this age. All of these plants appear to be Acrogens allied to Lycopodiaceæ. That these few species constitute the whole flora of the Upper Silurian we can scarcely believe. They occur in marine formations, and were probably drifted far from the somewhat limited land-surfaces which existed in the explored parts of the Upper Silurian areas. When we obtain access to deposits of this age formed in shallows or estuaries, we may hope to find a flora of greater richness; and, judging from present indications, not dissimilar from that of the Lower Devonian.

With the exception of some remains which I believe to be of very doubtful character, the Lower Silurian has as yet afforded no remains of land plants, and in North America, at least, this is very significant, inasmuch as we have, in the Potsdam sandstone, extensive sandy flats of this period, in which we might expect to find drifted trunks of trees, if such had existed. But the search is not hopeless, and we may yet find some estuary deposit on the margin of the ancient Laurentian continent, in whose beds the plants of that old land may occur.

Lastly, for reasons stated in a paper lately published in the Proceedings of the Geological Society, I believe that the extensive deposits of graphite, which exist in the Laurentian of Canada, are of vegetable origin, and possibly in part produced by land plants, as yet altogether unknown to us. If the Palæozoic was the age of Acrogens, the Eozoic may have been that of Anophytes and Thallophytes. Its plants may have consisted of gigantic mosses and lichens, presenting us with a phase of vegetable existence bearing the same relation to that of the Palæozoic, which the latter bears to that of more modern periods. But there is another and a more startling possibility, that the Laurentian may have been the period when vegetable life culminated on our planet, and existed in its highest and grandest forms, before it was brought into subordination to the higher life of the animal. The solution of these questions belongs to the future of geology, and opens up avenues not merely for speculation but also for practical work.

The above must be regarded as merely a sketch of the present aspect of the subject to which it relates. Details must be sought elsewhere.

J. W. DAWSON

NOTES

THE Royal Commission on Scientific Instruction and the Advancement of Science has already begun work. A second meeting was held on the 31st ult. at Devonshire House. Present: The Duke of Devonshire, K.G., chairman; the Marquis of Lansdowne; Sir J. Lubbock, Bart., M.P., F.R.S.; Sir J. P. Kay Shuttleworth, Bart.; Mr. B. Samuelson, M.P.; Dr. Sharpey, Sec. R.S.; Professor Huxley, F.R.S.; Dr. W. A. Miller, Treas. R.S.; and the secretary, Mr. J. Norman Lockyer, F.R.S.

A MEETING of the Syndicate appointed to consider the ways and means of establishing a Chair of Experimental Physics at Cambridge was held on Tuesday last.

WE may remind our Astronomical readers that the Visitation of the Royal Observatory at Greenwich takes place at 3 P.M. on Saturday.

THE annual meeting for the election of Fellows into the Royal Society was held this morning.

THE Geographical Society of Paris has bestowed a well-earned honour on our countryman, Mr. Alfred R. Wallace, by awarding him one of their gold medals for his researches in the Malay Archipelago.

AT the meeting of the French Academy, held on the 23rd ult., the following list of candidates for the place vacant by the death of Professor Magnus was presented by the Secret Committee:—1, Mr. Joule, 2, MM. Ångström, Billet, Dove, Grove, Henry, Jacobi, Lloyd, Riess, Stokes, Tyndall, Volpicelli, and Sir William Thomson.

THE Gresham lectures for the present week at the Gresham College, Basinghall Street, are by Dr. Symes Thompson, on the 2nd, 3rd, and 4th of June, at 7 P.M., on "The Epidemics of the Middle Ages," on "Sedatives," and on "Narcotics." They are free to the public, and will be illustrated with diagrams, tables, and chemical experiments.

THE municipal administration of Paris has decided on publishing a series of documents on the history of the capital. The commission appointed for this purpose has placed at the head of its programme a sketch of the pre-historic epochs, and has entrusted this labour to M. Belgrand, who is well known in the scientific world by his important works on the basin of Paris. In presenting to the Academy a *résumé* of his work, he divides it into four parts—the diluvian epoch, the great water-courses of the age of stone, the history of the peat-mosses, and the palæontological history of the basin of the Seine during the quaternary epoch. Our Common Council of London has a splendid opportunity of distinguishing itself in the same way; is it too much to expect of such an august body?

WE perceive with great pleasure that the Radcliffe Library at Oxford is being adapted more completely to the wants of students of science. Students in any department of natural knowledge, who need scientific works, maps, or plans which they do not find in the library, are invited to record their wants in a book kept for the purpose. There is a standard microscope, by Powell and Lealand, attached to the library, for the comparison of objects with the illustrated works of the library.

THE Royal Dublin Society have commissioned Mr. Catterson Smith to paint a portrait of Dr. Joly, to be placed in their library. It will be remembered that Dr. Joly presented the Royal Dublin Society with a large and valuable library of modern books. The society already possessed a library of works on Science and Fine Arts, which, however, was very deficient in works of modern literature. It will now, with the addition of the Joly library, be one of the most useful public libraries in Great Britain and Ireland.

THE Surgical Society of Ireland gave a grand *conversazione* to its members and to the medical men of Dublin on Tuesday, the 24th ult. His Excellency the Lord Lieutenant was present. The *conversazione* was held in the Royal College of Surgeons. The small museum of the college was lit up, and looked uncommonly well. A series of interesting microscopical objects were exhibited by Dr. Barker, Mr. William Archer, Rev. Eugene O'Meara, and others.

M. DE CALIGNY called the attention of the French Academy, at its meeting of the 16th of May, to two prizes founded in 1867 by the Marquis d'Ourches, for the indications of the means of preventing people from being buried alive. The first is a prize of 20,000 frs. for the discovery of a simple method of recognising with certainty the signs of actual death. This method must be adapted to the capacities of the most ignorant. The second, a prize of 5,000 frs., is for the discovery of a means of recognising death by means of electricity or galvanism, or by some other process requiring knowledge for its application. These prizes are to be decided by the Imperial Academy of Medicine, within five years from the 22nd April, 1868.

ONE of the best signs of the times we have seen lately is the third annual report of the Rugby School Natural History Society for 1869, as giving satisfactory evidence of the interest taken in natural science by at all events a few Rugbeians. The botanical report for 1869 records the dates of flowering of 340 plants, which seem to have been carefully observed for three successive years, and a few new localities or plants new to the neighbourhood. We find also a thoroughly Darwinian paper by Mr. J. M. Wilson on "A remarkable instance of protective mimicry among the *Lepidoptera*;" the well-known example of the female of *Papilio Merope*, with an illustration; one on "English Snakes and the Blind-worm," by Mr. N. Masterman, secretary of the society; an elaborate account by Mr. J. M. Wilson of the "Drifts, Gravels, and Alluvial Soils of Rugby and its neighbourhood," illustrated by some carefully-executed drawings; a paper by the Rev. T. N. Hutchinson "On Spectrum Analysis and what it has done;" and one on "Norway," by Mr. Sedgwick. Other papers not reported appear to have been read at the meetings, which must have been interesting ones. We believe no greater service can be rendered to the spread of a taste for natural science than an encouragement of these efforts at our public schools.

A NATURAL History Society has been organised in Baltimore, to be called the Maryland Academy of Sciences; its object being to promote scientific research, and to collect, preserve, and diffuse information relating to the sciences, especially those connected with the natural history of Maryland. Its first president is Philip T. Tyson; Vice-president, Dr. John G. Morris; Corresponding Secretary, Dr. Charles C. Bombaugh.

THE *Feuille des Jeunes Naturalistes* is a praiseworthy attempt by a small body of French naturalists to establish an international school journal of science and natural history for the boys of France, Germany, and England. Contributions, written in either of the three languages, are invited from any schoolboy; and they will be received from no other source. The proprietors are especially anxious to interest our English schools in their enterprise; and we gladly give publicity to a very novel and very admirable scheme. The subscription is four francs per annum. The editor is M. E. Dollfus, Dornach, Haut Rhin.

IN reference to Mr. Murphy's communication in our last number respecting the purplish pink colour of the sunlight, we learn from correspondents that it was noticed also at Tynemouth, at 5 P.M., on Sunday, the 22nd ult.; at Cambridge, at 10 A.M., on Monday, and in Gloucestershire on both these days. In all these cases the sky is described as being hazy at the time.

THE *American Gas-Light Journal* speaks of an invention which aims at the entire abolition of oils and all other lubricating material for boxes, slides, and every condition of motion where metallic friction is to be overcome or expected. It is claimed that such a result has been fully achieved, and there are engines now running with this material, which the proprietors aver have worked to complete satisfaction for weeks and months. It is the work of a scientific and practical gentleman, well known both in America and in Europe, who has spent a great many years in the study of physical forces and their effects, with especial reference to metals. The exact nature of the present invention cannot be given, for the reason that patents are being sought for in several countries in Europe, and any clear description of the materials and processes would be likely to defeat that end. It may, however, be said, in a general way, that the discovery—which has received the name of Metalline—consists of such combinations and manipulations of various metallic substances, as to make a surface on which the ordinary axles, cranks, pins, slides, &c., of iron, steel, brass, or any other metal, will run with much less friction, without heat that comes within the slightest possibility of danger, and without increase (in fact an actual decrease is claimed) of the motive power used. These, briefly, are the claims, and the inventor refers to a large number of trustworthy gentlemen who have examined and tried the thing, and speak from actual knowledge.

A MOVEMENT is being set on foot in Germany for an alteration in the laws regulating the sending of dangerous substances by rail. Hitherto ether, alcohol, phosphorus, &c., can only be sent by special trains plying but once a week between the principal stations. Dry guncotton is entirely excluded from the railways; manufacturers are in the habit of sending it moistened with a certain quantity of spirits of wine; it thereby loses its explosive properties and burns like ordinary cotton.

WE are glad to see "Cassell's Popular Educator" still devoting a large proportion of its space to science. In the June number articles occur devoted to the following natural sciences:—Ethnology, geology (illustrated with woodcuts, which we recognise as taken from well-known handbooks), botany (a continuation of a series of excellent elementary articles), mineralogy, meteorology, and the science of heat.

DR. C. H. SCHAIBLE, of the Royal Military Academy, Woolwich, sends us "The State and Education," an historical and critical essay, with special reference to Educational Reform. The subject is exhaustively treated under the heads—Historical Sketch of State education; Compulsory Instruction; State Instruction; Organisation of State Instruction in Germany; Voluntary Instruction; State Control of Instruction; and Reform of Education in England; and the general conclusion arrived at may be stated to be the necessity of general, compulsory, unsectarian, primary instruction for all children from six to fourteen years of age, under State control, and gratuitous for the poor.

AT a recent meeting of the French Horticultural Society, M. Duchartre gave a history of the investigations into the nature of the phenomenon of variegation. He considers it to be now completely established that variegation is of the nature of a contagious disease, which in the case of grafted plants can be communicated both from the stock to the graft and from the graft to the stock.

It has long been laid down as a maxim in botanical hand-books that variegation and double flowering never go together. Many botanists have, however recently doubted whether the law always holds good, and that the double phenomenon may sometimes occur appears now to be definitely established by an article contributed by Prof. Morren, of Liège, to the April and May number of the *Belgique Horticole*, in which he gives a description, accompanied by a drawing, of a wall-flower possessing both double flowers and variegated leaves. The plant has now been grown for several years by M. Em. Rodigas, of St. Trond.

M. Schutzenberger, Professor of Clinical Medicine at Strasburg, publishes an essay on higher instruction, in which he compares the system in vogue in France to those pursued in Germany, England, and America, and discusses the influence of the Napoleonic University system on the institutions for higher instruction.

Dr. R. Wolf, Professor at Zürich, reprints "The Discoveries of the Telescope, and their results in Astronomy," a lecture given at the public hall in Zürich.

From the same author we have a second part of a Manual of Mathematics, Physics, Geodesy, and Astronomy, copiously illustrated with woodcuts.

Professor Miquel, of the Hague, publishes the first part of a "Catalogus Musei botanici Lugduno-batavi," being a catalogue of the flora of Japan, with lists of the Japanese collections contained in the Leyden Herbarium.

The eighth volume of Dr. Frisch's collected works of Kepler, containing the "Collectanea ex codicibus Pulkoviensibus," the "Judicium matris Kepleri," and some smaller treatises, lies on our table.

A Magazine is now published at Heidelberg under the title *Annalen der Oenologie* devoted, entirely to the discussion of the cultivation of the vine and the manufacture of wine. It is edited by Dr. Blankenhorn and Dr. Rösler.

Perhaps the most extraordinary instance of excessive and depraved appetite on record is that of a French soldier, named Tarare, whose case is described in vol. XXI. of the *Dictionnaire des Sciences Médicales*, by Dr. Percy. He was born near Lyons, and came up to Paris, where his first exploit was to eat a basket of apples—at a friend's expense. On various occasions he swallowed a series of corks and other indigestible materials, which produced such violent colic that he was obliged to attend the Hotel Dieu, and whilst being examined almost managed to swallow the watch-chain and seals of the surgeon in attendance, M. Giraud. Desault, on the occasion of one of these attacks of colic, tried to frighten him out of his gross habits by declaring that it would be necessary to open his stomach, and arranged the instruments; he ran away, and relieved himself by copious draughts of warm water. Soon after he found that his appetite had really increased to an excessive amount, pro'ı bly owing to the continued irritation produced by these absurd tricks. At 17 years of age, when only weighing 100lb., he could eat 24lb. of beef in as many hours. He now entered the army, and being recognised by the Surgeon-Major, M. Courville of the 9th Regiment of Hussars, he was detained for the sake of curiosity. From the day of his admission, he was ordered quadruple rations, with pickings and waste meat, but often slipped into the dispensary to finish off a poultice or two. One day he was observed to seize a large cat: and, after sucking its blood, left, in a very short time, only cleanly picked bones, the hair being rejected in the course of about half an hour, like other carnivora. He was fond of serpents and eels, swallowing them whole. On another occasion he consumed in a few minutes a repast, spread out for fifteen German workpeople, of milk, &c., after which he was blown out like a balloon. In the presence of some officers he swallowed, at one sitting, 30lb. of liver and lights. His insatiable appetite was for once in his life made useful, by his being selected to convey a correspondence between General Beauharnais and a French colonel, which was inserted in a box and swallowed; but he was caught and soundly thrashed. He fell under suspicion of having eaten a child fourteen months old. It is stated that he was of mild and gentle manners and aspect. After death his stomach was found in a very diseased condition.

The Tyneside Naturalists' Field Club is not only one of the most vigorous and truly scientific in the country, but is nearly the oldest, and probably one of the largest, numbering 600 members. At its 24th anniversary meeting recently held, the following gentlemen were elected as officers, viz.:—President—Mr. George S. Brady; Vice-Presidents—the Revs. W. Featherstonehaugh, B.A., J. F. Bigge, M.A., H. B. Tristram, LL.D., W. Greenwell, M.A., G. C. Abbs, M.A., A. M. Norman, M.A., J. C. Bruce, LL.D., A. Bethune, M.A., and R. F. Wheeler, M.A., Sir W. C. Trevelyan, Bart., Drs. Embleton and Charlton, and Messrs. R. B. Bowman, Richard Howse, George Hodge, Ralph Carr, R. Ingham, T. Sopwith, Rowland Burdon, George Wailes, and E. J. I. Browell. Treasurer—Mr. R. Y. Green. Local Secretaries—Durham, Mr. John Booth; Hexham, the Rev. W. T. Shields; Morpeth, Mr. W. Creighton. Committee—Messrs. Thomas Atthey, Jos. Blacklock, T. J. Bold, James Clepham, John Coppin, W. Dinning, D. O. Drewett, Albany Hancock, John Hancock, Jos. Watson, A. F. Marreco, and Dr. Philipson. Auditors—Messrs. J. S. Foster, and T. P. Barkas.

We have received from the Canadian Government Emigration Office a copy of the Year-Book of Canada for 1870, containing a vast mass of information respecting British North America, which will be very useful to those interested in the country. It also contains an interesting paper on the Climatology of British North America, written by Mr. G. T. Kingston, the director of the Magnetic Observatory at Toronto; an account of the Educational Establishments, by Mr. J. C. Patterson, of Ottawa; and a paper by Mr. T. Cross on Mining in Canada, both of which are of interest. One of the chief points in the latter paper is the statement that mining in Canada is every year assuming a more steady and settled character. The gold working in Nova Scotia has given less favourable results than in 1867, but the falling off is ascribed to the depth at which the lodes were being worked, and the inadequate nature of the machinery employed. The total yield in 1868 was 20,541 ounces; and the inspector expresses the opinion that gold mining in the province is yet far from that development which may be expected.

M. l'Abbe Vaullet, director of the hospital of Annecy, believes, says *Les Mondes*, that he has proved that the temperature of the department of Haute Savoie has gradually risen in a very appreciable manner during the last forty years. The mean temperature, formerly 8° to 9° C., now exceeds 10·5°. The proofs he adduces are the advance of the cultivation of the vine, and of grain, and the retreat of the glaciers. The causes of this amelioration of the climate M. Vaullet considers to be the disforesting, the destruction of hedge-rows, the clearing of uncultivated lands, the multiplication and maintenance of roads, the draining of marshes, and the increase of population and of cattle.

Dr. Thomas Andrews has recently delivered two lectures in the chemical lecture-room of Queen's College, Belfast—the first on carbon, the second on carbonic acid and carbonic oxide. They form a portion of a course of strictly scientific lectures, the attendance being confined entirely to working men, the admission by ticket, but without charge. On each occasion the hall was crowded.

ON THE PROGRESS OF BOTANY DURING 1869*

I.

It had been my intention on the present occasion to have carried on the sketches of the general progress of biological science which I had attempted in 1862, 1864, 1866, and 1868; but I have, from various causes, being unable to bestow so much time as usual to the preparation of my address, and feel obliged to confine myself to a few points connected with subjects of special interest to myself, which, within the last two or three years, have made considerable advances.

The most striking are, without doubt, the results obtained from the recent explorations of the deep-sea faunas, and from the investigation of the tertiary deposits of the Arctic regions, which, although affecting two very different branches of natural science, I here couple together, as tending both of them to elucidate, in a remarkable degree, one of the most important among the disputed questions in biological history, the continuity of life through successive geological periods.

An excellent general sketch of the first discovery and progressive investigation of animal life at the bottom of the sea at great depths, up to the close of the season of 1868, is given by Dr. Carpenter in the Proceedings of the Royal Society, vol. xvii. No. 107, for December 17, 1868; the results of the still more important expedition of the past year have as yet been only generally stated by Mr. Gwyn Jeffreys, in the numbers of NATURE for Dec. 2 and 9, 1869; and by Dr. Carpenter in a lecture to the Royal Institution, published in the numbers of *Scientific Opinion* for March 23 and 30, and April 6 and 13 of the present year; and further details, as to the Madreporaria, are given by Dr. Duncan in the Proceedings of the Royal Society, 1 vol. xviii., No. 118, for March 24 of the present year; whilst, in North America, the chief conclusions to be drawn from those researches into the deep-sea fauna are clearly and concisely enumerated by Prof. Verrill, in the number of *Silliman's Journal* for January last, and some of the more detailed reports of the American explorations by Louis and Alexander Agassiz, and others, have been published in the Bulletin of the Museum of Comparative Zoology at Harvard College, Nos. 6, 7, and 9 to 13. For the knowledge of the data furnished by the Tertiary deposits of the Arctic regions we are indebted almost exclusively to the acute observations and able elucidations of Prof. O. Heer, in his "Flora Fossilis Arctica," in his paper on the fossil plants collected by Mr. Whymper in North Greenland, published in the last part of the Philosophical Transactions for 1869, and in the as yet only short general sketch of the results of the Swedish Spitzbergen expeditions, contained in the Genevan *Bibliothèque Universelle Archives Scientifiques* for December 1869.

It would be useless for me here to retrace, after Dr. Carpenter and Prof. Verrill, the outlines of the revolution which these marine discoveries have caused in the previously conceived theories, both as to the geographical distribution of marine animals, and the relative influences upon it of temperature and depth, and as to the actual temperature of the deep seas, or to enter into any details of the enormous additions thus made to our knowledge of the diversities of organic life; and it would be still further from my province to consider the geological conclusions to be drawn from them. My object is more especially to point out how these respective dips into the early history of marine animals and of terrestrial forests have afforded the strongest evidence we have yet obtained, that apparently unlimited permanency and total change can go on side by side without requiring for the latter any general catastrophe that should preclude the former.

There was a time, as we learn, when our chalk-cliffs, now high and dry, were being formed at the bottom of the sea, by the gradual growth and decay of Globigerinæ and the animals that fed on them; amongst others, for instance, *Rhizocrinus* and *Terebratulina Caput-serpentis*; and when the upheaval of the ground into an element where these animals could no longer live, arrested their progress in that direction, they had already spread over an area sufficiently extensive for some part of their race to maintain itself undisturbed, and so on from that time to the present day, by gradual dispersion or migration, in one direction or another, the same *Rhizocrinus* and *Terebratulina* have always been in possession of some genial locality, where they have continued from generation to generation, and still continue, with Globigerinæ and other animals, forming chalk at the bottom of the sea, unchanged in structural character, and rigidly conservative in habits and mode of life through the vast geological periods they have witnessed. So also there was a time when the hill sides of Greenland and Spitzbergen, now enveloped in never-melting ice and snows, were under a genial climate, clothed with forests, in which flourished *Taxodium distichum* (with *Sequoiæ*, *Magnoliæ*, and many others), and when these forests were destroyed by the general refrigeration, the Taxodium occupied an area extensive enough to include some districts in which it could still live and propagate; and whatever vicissitudes it may have met with in some parts, or even in the whole, of its original area, it has, by gradual extension and migration, always found some spot where it has gone on and thriven, and continued its race from generation to generation down to the present day, unchanged in character, and unmodified in its requirements. In both cases the permanent animals of the deep-sea bottom and the permanent trees of the terrestrial forests have witnessed a more or less partial or complete change in the races amongst which they were commingled. Some of these primitive associates, not endowed with the same means of dispersion, and confined to their original areas, were extinguished by the geological or climatological changes, and replaced by other races amongst which the permanent ones had penetrated, or by new immigrants from other areas; others again had spread like the permanent ones, but were less fitted for the new conditions in which they had become placed, and in the course of successive generations have been gradually modified by the Darwinian process of natural selection, the survivors of the fittest only among their descendants. If, in after times, the upheaved sea-bottom becomes again submerged, the frozen land becomes again suited for vegetation, they are again respectively covered with marine animals or vegetable life, derived from more or less adjacent regions, and more or less different from that which they originally supported, in proportion to the lapse of time and extent of physical changes which had intervened. Thus it is that we can perfectly agree with Dr. Duncan, that "this persistence (of type and species through ages, whilst their surroundings were changed over and over again) does not indicate that there have not been sufficient physical and biological changes during its lasting to alter the face of all things enough to give geologists the right of asserting the succession of several periods;" but we can, at the same time, feel that Dr Carpenter is in one sense justified in the proposition, that we may be said to be still living in the Cretaceous period. The chalk formation has been going on over some part of the North Atlantic sea-bed from its first commencement to the present day, in unbroken continuity and unchanged in character.

If once we admit as demonstrated the coexistence of indefinite permanency, and of gradual or rapid change of different races in the same area and under the same physical conditions, according to their constitutional idiosyncrasies, and also that one and the same race may be permanent, or more or less changing, according to local climatological or other physical conditions in which it may be placed, we have removed one of the great obstacles to the investigation of the history of races, the apparent want of uniformity in the laws which regulate the succession of forms. We may not only trace, with more confidence, such modifications of race through successive geological periods as Prof. Huxley has recently exhibited to us in respect of the horse, but we can understand more readily the absolute identity of certain species of plants inhabiting widely dissevered areas, of which the great majority of species are more or less different. One of the arguments brought forward against the community of origin of representative species in distant regions, such as temperate Europe and the Australian Alps, the Arctic Circle and Antarctic America, the Eastern United States and Japan respectively,—an argument which long appeared to me to have considerable weight,—was this:—that if disseverance and subsequent isolation results necessarily in a gradual modification by natural selection, how is it that when all are subjected to the same influences, the descendants of some races have become almost generically distinct in the two regions, whilst others are universally acknowledged as congeners, but specifically distinct, and others again are only slight varieties or have remained absolutely identical? To this we can now reply, with some confidence, that there is no more absolute uniformity in the results of natural selection than in any other of the phenomena of life. External influences act differently upon

* Address of G. Bentham, F.R.S., President of the Linnean Society, read at the Anniversary Meeting, May 24, 1870.

different constitutions. Were we to remove the whole flora and fauna of a country to a distant region, or, what comes to the same thing, change the external conditions of that flora and fauna, as to climate, physical influences, natural enemies, or other causes of destruction, means of protection, &c., we should now be taught to expect that some of the individual races would at once perish; others, more or less affected, might continue through several generations, but with decreasing vigour, and, in the course of years or ages, gradually die out, to be replaced by more vigorous neighbours or invaders; others again might see amongst their numerous and ever-varying offspring some few slightly modified, so as to be better suited for the new order of things; and experience has repeatedly shown that the change once begun may go on increasing through successive generations and a permanent representative species is formed, and some few races may find themselves quite as happy and vigorous under their new circumstances as under the old, and may go on as before, unchanged and unchanging.

Taking into consideration the new lights that have been thrown upon these subjects by the above investigations and by the numerous observations called forth by the development of the great Darwinian theories, amongst which I may include a few points adverted to in a paper on Cassia which I laid before you last year, it appears to me that in plants, at least, we may almost watch, as it were, the process of specific change actually going on, or at least we may observe different races now living in different stages of progress, from the slight local variation to the distinct species and genus. As a first step we may take, for instance, those races which are regarded by the majority of botanists as very variable species, such as *Rubus fruticosus*, *Rosa canina*, *Zornia diphylla*, *Cassia mimosoides*, &c.: we shall find in each some one form, which we call typical, generally prevalent over the greater part of the area of the race, whilst others more or less aberrant are more or less restricted to particular localities, the same varieties not occurring in disconnected stations with precisely the same combinations of character; and in the same proportions local and representative varieties and sub-species are being formed, but have not yet obtained sufficient advantages to prevent their being kept in check by their inter-communication (and probable cross-breeding) with their more robust type. The British rubologist or rhodologist transported to the south of France or to Hungary will still find one, or perhaps two or three, forms of bramble and dog-rose with which he is familiar; but if he wishes to discriminate the thirty or forty varieties or sub-species upon which he had spent so much labour and acuteness at home, he will find that he must recommence with a series of forms and combinations of characters quite new to him. The species is still the same; the varieties are changed. As examples of what we may call a second stage in the formation of species, we may adduce such plants as *Pelargonium australe* or *grossularoides* and *Nicotiana suaveolens* or *angustifolia*, to which I alluded in the above-mentioned paper on *Cassia*. Here we have one race, of no higher than specific grade in the ordinary acceptance of the term, inhabiting two countries which have long been widely dissevered (in the one case South Africa and Australia, in the other Chili and Australia), which, if originally introduced by accident from one country to the other, have been so at a time so remote as thoroughly to have acquired an indigenous character in both; in both are they widely spread and highly diversified, but amongst all their varieties one form only is identical in the two countries (*Pelargonium australe*, var. *erodiodes*, and *P. grossularioides*, var. *anceps*; *Nicotiana suaveolens*, var. *angustifolia*, and *N. angustifolia*, var. *acuminata*), and that so comparatively a rare one that it may be regarded as being in the course of extinction; whilst all other varieties, some of them very numerous in individuals over extended areas, and all connected by nice gradations, diverge nevertheless in the two countries in different directions and with different combinations of characters, no two of them growing in the two countries being at all connected but through the medium of that one which is still common to both. When that shall have expired the distinct species may be considered as established. A still further advance in specific change is exemplified in *Cassia* itself, in which I have shown that no less than eight or nine different modifications of type, sectional and subsectional, are common to South America, tropical Africa, and Australia, but without any specific or, at least, sub-specific identity, except perhaps in a few cases where a more modern interchange may be presumed. The original common specific types are extinct, the species have risen into sections. Common types of a still higher order have disappeared in the case of Proteaceæ, an order so perfectly natural and so clearly defined that we cannot refrain from speculating on the community of origin of the African and of the Australian races, both exceedingly numerous and reducible to definite groups—large and small well-marked genera in both countries, and yet not a single genus common to the two; not only the species, but the genera themselves, have become geographical. As in the varieties of *Pelargonium* and *Nicotiana*, so in that of the species of *Cassia* and of the genera of Proteaceæ, it is not to be denied that precisely similar modifications of character are observed in the two countries; but these modifications are differently combined, the changes in the organs are differently correlated. In Asiatico-African *Chamæcristes* a tendency to a particular change in the venation of the leaflet is accompanied by a certain change in the petiolar gland; in America the same change in the gland is correlated with a different alteration in the venation. In Australian Proteaceæ the glands of the torus are constantly deficient, with a certain inflorescence (cones with imbricate scales), which is always accompanied by them in Africa.

In selecting the above instances for illustration of what we may, without much strain upon the imagination, suppose to be cases of progressive change in races, it is not that they are isolated cases or exceptionally appropriate; for innumerable similar ones might be adduced. In the course of the detailed examination I have had successively to make of the floras of Europe, N.W. America, tropical America, tropical Africa, China, and Australia, I have everywhere observed that community of general type, in regions now dissevered, is, when once varied, accompanied by more or less of divergence in more special characters in different directions in the different countries.

G. BENTHAM

SURFACE-OCEANIC LIFE

IN the waiting-room at the Admiralty is a drawing 12 feet by 8 feet, which is attracting the attention of numerous scientific and naval men, who thoroughly appreciate the novel and complete manner in which the several groups of interesting marine life have been arranged, and the system and regularity upon which the arrangement has been carried out, and we may also add, for the benefit of the curious, that the beauty and colour of these grotesque forms would exceed the imagination of Gustave Doré. The work was entirely executed in H.M.S. *Rodney*, on her passage from China to England during the last six months, and extends over the China Sea, Indian and Atlantic Oceans. The subject of surface-oceanic life is particularly acceptable at the present time, as Dr. Carpenter, Mr. Gwyn Jeffreys, and Professor Wyville Thomson were last season engaged in examining the deep-sea life of the neighbouring ocean, and are likely to extend their investigations into the Bay of Biscay and Mediterranean Sea during the summer. These deep sea explorations should be energetically pursued, and we may earnestly hope that it will not be long before an honest rivalry is maintained in the Atlantic and European seas, and that other oceans and parts of the world may be dipped into by voyagers, for contributions to this useful branch of science.

Those who only know the sea under the aspect which it usually presents round our own coasts will hardly be acquainted with the fact that the surface of the ocean forms a world in itself, inhabited by myriads of strange and delicate creatures, as distinct in its conditions from the shore world as from the inhabitants of the dark mysterious depths whose oozy plain, shut off from the day by three miles' thickness of water, is tenanted by the lingering and stunted refugees of a world of animals now for the most part extinct. The creatures which inhabit the surface of the ocean are very many of them born and bred there; others, on the contrary, have left their parents at a very early age, being carried away from the shore by surface currents and drifted out to sea, there to pass through ever-changing forms, until the time comes for their return to shallower places and a life of grovelling on the ground. Although this picture contains more than six hundred drawings of marine animals, it does not represent much more than one-third of the actual labour incurred, duplicate and fac-simile drawings of all the creatures having been originally made. The author of this picture, Mr. Francis Ingram Palmer, has been employed surveying the coasts of Japan and China, and it was on his passage home that he devoted his attention to this subject.

SCIENTIFIC SERIALS

Max Schultze's Archiv für Mikroskop Anatomie, Band vi. Heft. 2, 1870, is a paper by M. J. C. Eberth on the termination of the Cutaneous Nerves. Eberth's experiments were undertaken upon the skin of man, of rabbits, guinea-pigs, dogs, and cats, but chiefly on that of man and of Albino rabbits; the processes of pigment cells in the other animals often closely resembling nerves when stained with gold chloride. The strength of the solution that was used varied from ½ to 1 per cent., in which portions of skin were allowed to soak for from ¼ to 4 hours. In the cutis of man the nerves form first a rich web of dark-edged fasciculi, which break up into a plexus of fine fibrils and small fasciculi of fibrils. These soon lose their medullary sheath, and enter more or less vertically into the papillæ in the form of fine axis cylinders with fusiform nuclei lying upon them. He particularly insists that the final finest terminations which can be followed to the attached surface of the epithelium are free and do not form a plexus. He corroborates the statements of Langerhans respecting the presence of peculiar cells in the deeper parts of the epidermis of stellate and fusiform shape; often with a distinct nucleus. They blacken with chloride of gold; but neither Eberth nor Langerhans have been able to trace their connection with nerves. These cells usually send off from five to eight simple or branched processes towards the surface, but only one or two towards the cutis.

In the *Annales des Sciences Naturelles, Zoologie*, Paris, 1870, p. 1, is a contribution by M. Léon Vaillant to the anatomical investigation of the genus Pontobdella, the principal points of which we extract. M. Vaillant states that he has had peculiar opportunities of observing this genus of the Hirudinidæ, and the particular species he has investigated is that of the *P. verrucata*, so called on account of the proper zoonites or segments of the animal supporting four tubercles, though the *cutaneous* segments or zoonites only bear two. The total number of cutaneous zoonites is 67. The anterior orifice of the digestive system is placed at the centre of the anterior sucker. The posterior orifice opens dorsally just in front of the posterior sucker. The skin presents a dermis and an epidermis, the latter being composed of a delicate cuticle and of a layer of epithelial cells, corresponding to the pigmentary layer of Moquin Tandon. The dermis is composed of cells concealed by a network of what appear to be anastomosing tubes. Beneath the skin, and almost forming part of it, is a dense layer of smooth muscular tissue, the external fibres of which are circular, the deeper longitudinal. By the agency of these the locomotion of the animal is chiefly effected. Between the muscular layer and the digestive tube an immense number of yellow granules are found, which appear to be of the same nature as the unicellular glands described by Leydig, possessing fine ducts, that can in some instances be followed to the skin, and therefore almost precluding the idea of their being hepatic organs. The nervous system presents 22 ganglia, excluding the œsophageal collar; the last one is the largest, and is found in the anal sucker. No eyes have been discovered in them, and their relations to the outer world appear to be restricted to those derived from the sense of touch. The digestive organs present no remarkable deviations from that of the leeches in general. Its divisions are a proboscis, with its sheath; a crop; the gastro-ilial portion, and the rectum. The jaws are reduced to three minute projecting points. The crop extends quite to the posterior part of the body, and presents a series of constrictions. The gastro-ilial portion is a single tube lying above the *cul de sac*, formed posteriorly by the ingluvies, and appears to correspond to the true stomach of other animals. The circulation is effected through a closed system of vessels, and the contents of these vessels are colourless, and destitute of corpuscles. M. Vaillant considers that the blood is represented properly by the fluid contained in the general cavity of the body, which contains definite morphological elements. There are four principal vessels, a dorsal, ventral, and two lateral, and these lie in the muscular layers. The dorsal and ventral vessels communicate freely by large branches; the lateral vessels receive their blood from a delicate plexus of vessels distributed on the intestine, which, however, communicates with the dorso-ventral system; and it is probable that an oscillation of the fluid is constantly occurring from one set of vessels into the other. On the whole, the vascular system is much less complicated here than in the leech. The respiratory function is effected essentially if not exclusively by the skin, and there is no special organ for its performance. In regard to the secretions, reference has already been made to the unicellular glands of the skin; and the only others are some peri-œsophageal glands, which are generally considered to be salivary, and the muciparous follicles, which are ovoid vessels, six in number, on each side, placed in the testicular region, and opening externally with a ciliated orifice. The sexes are united in the same individual. The eggs are deposited either separately or several together enveloped in a common capsule.

In the third part of M. Brown Séquard's "*Archives de Physiologie*" are the results of an investigation of the mode in which nerves terminate in smooth muscular tissue, by M. Hénocque. He has examined the smooth muscles of numerous vertebrate animals and of man, with a great variety of reagents, as serum, pyroligneous acid, chromic acid, and chloride of gold and potassium, which in a strength of one part in 200 he particularly recommends. He finds that the appearances presented are the same in all animals, and in all organs; and states that in following out the nerves towards their peripheral terminations, they may be found to form three plexuses or networks—namely, a fundamental plexus, with which numerous ganglia are associated, and which is situated *outside* the smooth muscle; an intermediate plexus; and lastly an intra-muscular plexus situated in the interior of the fasciculi of smooth fibres. The terminal fibres are everywhere identical, they divide dichotomously or anastomose, and end in a slight button or swelling, or in a punctiform manner. These little buttons are seated in various parts of the smooth muscular fibre, more frequently round the muscles or at the surface of the muscular fibres, or, finally, between them.

The *American Naturalist* for May commences with an interesting article on the Indians of California, their manners and customs, by Edward E. Chever; followed by one on the "Time of the Mammoths," by Professor N. S. Shaler, in which he gives a full account of the geological distribution on the American continent of the different species of the genus *Elephas*. W. G. Binney contributes a paper on the "Mollusks of our Cellars."

In the *Revue des Cours Scientifiques* for May 21 we have M. Faye's important paper on the form of Comets, which occupied one of the *Soirées Scientifiques de la Sorbonne*, and a continuation of M. Bernard's series on Suffocation by the Fumes of Charcoal. In the number for May 28 is an epitome of M. Belgrand's *résumé*, presented to the Academy of Sciences, of the prehistoric history of the Paris basin, to which we refer in another column; the Rectorial Address, by M. H. Kopp, to the University of Heidelberg, on the State of Science during the Middle Ages; and a paper by M. Bert on Physiology and Zoology.

SOCIETIES AND ACADEMIES

London

Royal Society, May 19.—A paper was read, entitled "On the Effects of Alcohol (*Ethyl Alcohol*) on the Human Body," by Dr. Parkes and Count Cyprian Wollowicz. The experiments given in detail by the authors were undertaken with a view of testing the physiological and especially the dietetic effects of alcohol, and to clear up some points left doubtful by previous observers. They were fortunate in obtaining as the subject of experiment a healthy and very intelligent soldier at twenty-eight, 5 feet 6 inches in height, weighing from 134lb. to 136lb., with a clean, smooth skin, a clear bright eye, good teeth, largely developed, powerful muscles, and but little fat. As he had been accustomed to smoke, he was allowed half an ounce of tobacco daily, lest the deprivation of it might disturb his health. The amount of alcohol administered varied, but it was never carried so far as to produce any extreme symptoms of narcotism.

The plan of observation was as follows:—For twenty-six days the man remained on a diet precisely similar as to food and times of meals in every respect, except that for the first eight days he took only water (in the shape of coffee, tea, and simple water); for the next six days he added to this diet rectified spirit, in such proportion that he took, in divided quantities, on the first day one fluid ounce (= 28 c. c.) of absolute alcohol; on the second day two fluid ounces; on the third day four ounces, and on the fifth and sixth days eight ounces on each day. He then returned to water for six days, and then for three days took on each day half a bottle (= 12 ounces, or 341 c. c.) of fine brandy, containing 48 per cent. of alcohol. Then for three days more he returned to water.

There were thus five periods, viz., of water-drinking, alcohol, water, brandy, water.

Before commencing the experiments, the man, who had been accustomed to take one or two pints of beer daily, abstained altogether from any alcoholic liquid for ten days.

During the first few days there was a gradual increase in weight, owing probably to the food being rather greater and the exercise less than before; equilibrium was reached on the eighth day, and the weight remained almost unchanged during the alcoholic period. There was slight decrease after alcohol; and on the last brandy day a slight increase, which was maintained in the after period. The general result appears to be that (other conditions remaining constant) the effect of alcohol in modifying weight is quite unimportant. The results of the experiments may best be given in relation to the different functions of the body; and first in regard to the temperature of the axilla and rectum, it appeared that when taken as above described, alcohol and brandy produced little change in the temperature of either the axilla or rectum; but what effect there was, was rather in the direction of increase than of diminution. Secondly, in regard to the circulation, it was found that the pulse was increased both in frequency and volume, rising in number from 77·5 before alcohol to a max. of 94·7 with the largest doses. The capillary circulation was increased, shown by flushing of face and neck, &c. As conclusions from the sphygmographic observations that were made, it followed that there was increased frequency of the ventricular contractions of the head, and increased rapidity of each contraction, the ventricle therefore doing more work in a given time, the period of the heart being much shortened, and the blood moving more freely through the capillaries, so that the increased quantity of blood which it is to be presumed was thrown into the arteries, was very quickly got rid of. Thirdly, in regard to its action on the renal secretions, the authors show there was a decided increase in the amount of water eliminated; but they demonstrate in opposition to previous experimenters that, as long as the ingress of nitrogen is the same, 8oz. of absolute alcohol and 12oz. of brandy have no effect, or only a trifling effect, on the processes which end in the elimination of nitrogen by the urine, and most decidedly do not lessen the elimination. Further, the influence of alcohol on the elimination of chlorine and phosphoric acid, and upon the free acidity of the urine, is inconsiderable. The action of alcohol on the elimination of nitrogen by the alvine discharges was probably inconsiderable, and no experiments were made upon its effects upon the pulmonary excretion.

Putting together the evidence derived from the pulse as felt by the finger, from the state of the cutaneous vessels, and from the sphygmographic tracings, it seems fair to conclude that the chief effects of alcohol on the circulation in health are on the ventricles (the rapidity with which contractions are accomplished being greatly increased), and on the capillaries (which are dilated and allow blood to pass more freely through them).

As regards the mode in which alcohol is eliminated from the body from the application of a colour test, they are of opinion that a good deal must be eliminated by the lungs, and still more by the skin. Some also, though only a small proportion, must be given off by the renal and alvine discharges.

They found that one or two fluid ounces of absolute alcohol, in divided doses, increased the appetite; 4oz. lessened it, and larger quantities almost entirely destroyed it.

Estimating the daily work of the heart at 122 tons lifted one foot, the heart during the alcoholic period did daily work in excess equal to lifting 15·8 tons one foot, and in the last two days did extra work to the amount of 24 tons lifted as far. After the alcohol was omitted, the heart showed signs of weakness.

From the general results of the experiments, it appears, that any quantity over 2oz. of absolute alcohol would certainly do harm to this man, and that as every function was performed perfectly without it, its use was wholly unnecessary. They concluded by remarking that they were hardly prepared, notwithstanding their previous experience, for the ease with which appetite may be destroyed, the heart unduly excited, and the capillary circulation improperly increased. Yet they recognise the great practical benefit that may be derived from the use of alcohol in rousing a failing appetite, exciting a feeble heart, and accelerating a languid capillary circulation, though, for these objects to be fulfilled satisfactorily, there is necessity for great moderation and caution.

Ethnological Society, May 24.—Anniversary meeting, Prof. Huxley, president, in the chair. The report of the council and the treasurer's report were read and adopted. These reports showed that the position of the society was highly satisfactory. The President delivered an address, in which he gave a history of the efforts which have been made for amalgamating the Ethnological and Anthropological Societies, and hinted at the desirableness of union being effected between several societies having kindred objects. He also referred to the encouragement which the British Association had, since the Nottingham meeting, given to ethnological science, by allowing the Biological section (D) to resolve itself into departments. The following is the result of the ballot for officers and council:—President, Prof. Huxley, LL.D., F.R.S. Vice-presidents: Dr. A. Campbell, Sir John Lubbock, Bart., M.P., F.R.S., E. B. Tylor, Thomas Wright. Honorary Treasurer: H. G. Bohn. Honorary General Secretary: Colonel A. Lane Fox. Honorary Foreign Secretary: Hyde Clarke. Council: W. Blackmore, Prof. Busk, F.R.S., G. Campbell, Dr. Barnard Davis, W. Boyd Dawkins, F.R.S., J. Dickinson, Robert Dunn, J. W. Flower, David Forbes, F.R.S., A. W. Franks, Rev. Canon Greenwell, A. Hamilton, F. Hindmarsh, T. McK. Hughes, Dr. Richard King, Sir R. I. Murchison, Bart., K.C.B., J. F. McLennan, Rev. Dr. Nicholas, E. B. Pusey.

Linnean Society, May 24.—Anniversary meeting. The officers and council for the year 1870-71 were elected as follows:—President, G. Bentham, F.R.S. Treasurer, W. Wilson Saunders, F.R.S. Secretaries: F. Currey, F.R.S., and H. T. Stainton, F.R.S. Members of the Council: Thos. Anderson, M.D., John Ball, F.R.S., J. J. Bennett, F.R.S., George Busk, F.R.S., M. Foster, M.D., A. Grote, J. D. Hooker, M.D., F.R.S., Henry Lee, Major Parry, R. C. A. Prior, M.D., T. Thomson, M.D., F.R.S.

Short obituary notices having been read of fourteen fellows and five foreign members who had died during the year, the President proceeded to deliver his annual address, of which a full report will be found in another column.

Geological Society, May 11.—Joseph Prestwich, president, in the chair. Sir William Bagge, Bart., M.P., Colonel James Leslie Tait, and Dr. C. C. Carwana, were elected Fellows of the Society.

"Notes on some specimens of Lower Silurian Trilobites." By E. Billings, F.G.S., Palæontologist of the Geological Survey of Canada.

The author first described a specimen of *Asaphus platycephalus*, in which the hypostome was not only preserved *in situ*, but also the remains (more or less well preserved) of eight pairs of legs, corresponding with the eight segments of the thorax, to the underside of which they had been attached. The appendages take their rise close to the central axis of each segment, and all curve forwards, and are thus most probably ambulatory rather than natatory feet. They appear to have had four or five articulations in each leg. Three small ovate tubercles on the pygidium may, perhaps, indicate the processes by which the respiratory feet were attached. Mr. Billings referred to the large number of Trilobites which have been examined, and expressed his belief that only the most perfectly preserved specimens are likely to have the organs on the underside preserved. Mr. Billings next described the doublure or pleura in the Trilobites, comparing it to that of *Limulus*. He then proceeded to describe a row of small scars and tubercles on the underside of the pleuræ, to which both Dr. Volborth and Dr. Eichwald believed soft swimming feet or hard horny legs had been attached. As these were first seen by Dr. Pander in a Russian Trilobite, Mr. Billings has called them "Panderian organs." He thinks, soft natatory appendages may have been attached to these scars. Mr. Billings directed attention to the *Protichnites* and *Climactichnites*, which he thinks may now be referred to *Crustacea*, belonging to the division *Trilobita*. Finally, he described a section of a rolled-up *Calymene senaria*, the interior cavity of which appears to be full of minute ovate bodies, from $\frac{1}{80}$ to $\frac{1}{100}$ of an inch in diameter. These small ovate bodies the author believes to be eggs.

"Note on the palpus and other appendages of *Asaphus*, from the Trenton Limestone, in the British Museum." By Henry Woodward, F.G.S., F.Z.S.

Mr. Woodward, when comparing the Trilobite sent over by Mr. Billings with specimens in the British Museum, presented by Dr. J. J. Bigsby, F.R.S., discovered upon the eroded upper surface of one of these, not only the hypostome exposed to view, but also three pairs of appendages, and what he believes to be the palpus of one of the maxillæ. This furnishes an additional fact to Mr. Billings's most interesting discovery, besides confirming its correctness. Mr. Woodward considers the so-called "Panderian organs" to be only the fulcral points upon which the pleuræ move, and showed that such structures exist in most recent Crustacea. He considered that the evidence tended to place the Trilobita near to, if not in, the Isopoda Normalia, and remarked that the prominence of the hypostome reminded one strongly of that organ in *Apus*, and suggested that we might fairly expect to find that the Trilobita presented a more generalised type of structure than their representatives at the present day, the modern Isopoda.

"On the Structure and Affinities of *Sigillaria*, *Calamites*, and *Calamodendron*." By J. W. Dawson, LL.D., F.R.S., F.G.S., Principal and Vice-Chancellor of M'Gill University, Montreal. The object of this paper was to illustrate the structure and affinities of the genera above named, more especially with reference to the author's previous papers on the "Structures in Coal," and the "Conditions of Accumulation of Coal," and to furnish new facts and conclusions as to the affinities of these plants. With reference to *Sigillaria*, a remarkably perfect specimen of the axis of a plant of this genus, from the coal-field of Nova Scotia, was described as having a transversely laminated pith of the *Sternbergia* type, a cylinder of woody tissue, scalariform internally, and reticulated or discigerous externally, the tissues much resembling those of Cycads. Medullary rays were apparent in this cylinder; and it was traversed by obliquely radiating bundles of scalariform vessels or fibres proceeding to the leaves. Other specimens were adduced to show that the species having this kind of axis had a thick outer bark of elongated or prosenchymatous cells. The author stated that Prof. Williamson had enabled him to examine stems found in the Lancashire coal-field, of the type of Binney's *Sigillaria vascularis*, which differed in some important points of structure from his specimens; and that another specimen, externally marked like *Sigillaria*, had been shown by Mr. Carruthers to be more akin to *Lepidodendron* in structure. These specimens, as well as the *Sigillaria elegans* illustrated by Brongniart, probably represented other types of Sigillarioid trees, and it is not improbable that the genus *Sigillaria*, as usually understood, really includes several distinct generic forms. The author had recognised six generic forms in a previous paper, and in his "Acadian Geology;" but the type described in the present paper was that which appeared to predominate in the fossil Sigillarian forests of Nova Scotia, and also in the mineral charcoal of the coal-beds. This was illustrated by descriptions of structures occurring in erect and prostrate *Sigillariæ*, on the surface of *Sternbergia*-casts, and in the coal itself. The erect Calamites of the coal formation of Nova Scotia illustrate in a remarkable manner the exterior surface of the stems of these plants, their foliage, their rhizomata, their roots, and their habit of growth. Their affinities were evidently with *Equisetaceæ*, as Brongniart and others had maintained, and as Carruthers and Schimper had recently illustrated. The internal structure of these plants, as shown by some specimens collected by Mr. Butterworth, of Manchester, and soon to be published by Prof. Williamson, showed that the stems were more advanced in structure than those of modern *Equiseta*, and enabled the author to explain the various appearances presented by these plants, when the external surface is preserved, wholly or in part, and when a cast of the internal cavity alone remains. It was further shown that the leaves of the ordinary Calamites are linear, angular, and transversely wrinkled, and different from those of the *Asterophyllites* properly so called, though some species, as *A. comosus*, Lindley, are leaves of Calamites. The *Calamodendra*, as described by Cotta, Binney, and others, and further illustrated by specimens from Nova Scotia, and by several interesting and undescribed forms in the collection of Prof. Williamson, are similar in general plan of structure to the Calamites, but much more woody plants; and, if allied to *Equisetaceæ*, are greatly more advanced in the structure of the stem than the modern representatives of that order. Specimens in the collection of Prof. Williamson show forms intermediate between Calamites and *Calamodendron*, so that possibly both may be included in one family; but much further information on this subject is required. The tissues of the higher *Calamodendra* are similar to those of Gymnospermous plants. The wood or vascular matter of the thin-walled Calamites consists of multiporous cells or vessels, in such species as have been examined. In conclusion, a table was exhibited showing the affinities of *Sigillariæ* on the one hand, through *Clathraria* and *Syringodendron* with *Lycopodiaceæ*; and on the other hand, through *Calamodendron* with *Equisetaceæ*; while in the other direction they presented links of connection with Cycads and Conifers.

"Notes on the Geology of Arisaig, Nova Scotia." By the Rev. D. Honeyman, D.C.L., F.G.S. The author referred to a previous paper on the Upper Silurian Rocks of Nova Scotia, which he stated appeared to him now to be generally repetitions of his Arisaig series. He noticed the occurrence of fossils in one of the beds previously supposed to be almost destitute of organic remains, and described the occurrence, in Arisaig township, of a band of crystalline rocks which appeared to contain *Eozoon*, and were probably of Laurentian age. A note from Prof. Rupert Jones, giving an account of the fossils referred to by Dr. Honeyman, was also read.

Chemical Society, May 19.—Warren De la Rue, F.R.S., vice-president, in the chair. Mr. S. H. Johnson was elected a fellow. Mr. Griffin exhibited and explained a new gas furnace which is capable of melting about three pounds of iron in little more than one hour.—Mr. Walenn described an advantageous method for coating cast-iron objects by electrolysis with copper or brass. The special peculiarity of the method consists in the circumstance that no hydrogen is evolved during the process. A calico printing valse and other articles, coated with brass, in this manner, were submitted to the inspection of the assembly.—Mr. Tookey, Assayer in the Japanese Imperial Mint, communicated a paper "On the Manipulations of Assays of Gold and Silver Bullion." The number of separate processes from the first weighing in of a piece of gold bullion to the second weighing out before its value can be ascertained are well known to all assayers. The author saves a good deal of time by proceeding in the following manner:—The bullions are placed in conical shaped platinum tubes, which, at their narrow ends, are closed with a perforated plate, and at the wider end are provided with a shoulder, so that they can be supported by a porcelain tile having circular holes. The tubes and holes are numbered. The entire arrangement is then immersed in hydric nitrate, &c.; in short, proceeded with as if a single bullion, instead of a batch of them had to be treated. With regard to the assay of silver bullion, the hammering and brushing of the buttons after they have been detached from the cupels, may be dispensed with by placing those buttons into the perforated cavities of a platinum plate, where they are fastened by a platinum wire, and immersing the plate in pure hydric chloride, which will dissolve all the bone ash adhering to the buttons. The cavities of the plate are numbered to correspond with the cupels in the muffle.—Mr. Perkin read a note "On some Bromine derivatives of Coumarin." The following definite compounds have been obtained by treating coumarin with bromine in different ways: dibromide of coumarin, $C_9 H O_2 Br_2$; bromo-coumarin, $C_9H_5 BrO_2$, and dibromo-coumarin, $C_9H_4Br_2O_2$. All the three compounds are easily soluble in hot alcohol, from which they crystallise out on cooling. Dibromide of coumarin fires at about 100°, bromo-coumarin at 110°, dibromo-coumarin at 174°. The two latter compounds form, when boiled with an aqueous solution of potassic hydrate, potassium salts of new acids, probably bromo, and dibromo-coumaric acids.—Dr. Divers made some remarks "On the precipitation of solutions of ammonic carbonate, sodic carbonate, and ammonic carbonate by calcic chloride." The results of these experiments are chiefly of interest as supplying a characteristic reaction for the carbonate. When ammonic carbonate is added in excess to an aqueous solution of ammonia and calcic chloride, the calcic carbonate is precipitated very slowly in the cold, whilst such precipitate is instantly produced when ammonic carbonate is added to a solution of caustic ammonia and calcic chloride in water.—Dr. Thudichum made a short communication about having obtained hydric acetate from fresh urine, which fact contradicts the statements of Berzelius, Lehmann, and Liebig.

EDINBURGH

Institution of Engineers, April 19.—Professor Macquorn Rankine, C.E., LL.D., president, in the chair.—"On the Patent Law." By Mr. R. S. Newall. After some general remarks Mr. Newall proceeded as follows:—In brief, then, my propositions are:—The appointment of a standing commission who shall examine, in public, all petitions and specifications, &c., before the granting of a patent. That when once a patent is granted, it shall be held as valid, if not assailed within two years, under certain conditions. I do not see why the inventor's letters patent should not be made as secure and held as sacred as the title-deeds of any kind of property. The commissioners to be selected by the Privy Council from among men who are intimately acquainted with the arts and the sciences. I would extend the term of the patent to twenty years, and make the cost payable in four periods of five years, charging 50*l.* for each. This also might tend to restrict the number of patents applied for. I would leave the granting of licenses entirely to the patentee. It may suit his convenience to carry on the manufacture of his invention himself, better than to grant licenses to others to oppose him; and if he has the monopoly conferred upon him, he ought to be allowed to make use of it as he thinks proper. You have no more right to demand that a monopolist should grant a license than I have to drive my cattle into my neighbour's field. It appears to me to be absolutely impossible to fix the price for royalty on the granting of a patent; that, of course, must altogether depend upon the value of the invention, which cannot possibly be ascertained until some years after the patent is granted. We might as well attempt to fix the price for ten years of any commodity sold by shopkeepers, or of land to be sold. I propose to grant patents for inventions, whether they are made by foreigners or British subjects. I would propose the infliction of imprisonment in the case of any one infringing a patent, and having previously been convicted of the same offence. If this remedy were adopted we should have fewer rogues to deal with in patent cases, and the inventor might have the enjoyment of his monopoly. Since I began my proposed amendment of the patent laws in 1848, I have had more dishonesty to contend with than I hope may ever fall to the lot of any patentee. I have had fourteen years' litigation in defending the patent for my invention "for laying down submarine cables" against infringement, by Glass and Elliot, the Telegraph Construction Company, and others. Instead of being rewarded for a most valuable invention, without which the Atlantic, Indian, and other cables could not have been laid down, I have had to spend years in attending to law, and the expenses have amounted to thousands of pounds, whilst the pirates have made large fortunes by means of my invention.

PHILADELPHIA

American Philosophical Society, April 15.—Prof. Cope exhibited the greater part of the skeleton of an extinct crocodilian from the Cretaceous Greensand of New Jersey, which represented a new species of the genus *Bottosomus*, which he called *B. tuberculatus*. It displayed marked characters of the genus not before ascertained. Dr. Hayden called attention to numerous points in the topography and geology of the Rocky Mountain region, exhibiting photographs in illustration of them.

May 6.—A paper by Prof. Alex. Winchell, of the University of Michigan, was read, entitled, "On the Geological Character and Equivalents of the Marshall Group in the United States."—An obituary notice of Horace Binney, jun., was read by Prof. C. J. Stille.—A description of some beads of complex construction found in an Indian grave on the Susquehanna River, in Pennsylvania, by Prof. S. S. Holdeman, was read by the Secretary. They were described as ovoid, apparently made from parts of four concentric cylinders of blue and white material, the blue ridged so as to give a striated appearance to the coloration.—Prof. Harrison Allen read a paper entitled, "Some effects of Age, as observed in the Osseous System," illustrated by changes in the forms of the pterygoid alæ, malar bone, &c.—Prof. Cope read a paper "On the Fishes of the Tertiary Shales of Green River, Wyoming territory," in which the fragment of the fauna described was indicated as presenting resemblances to that of Monte Bolca. Prof. Cope also exhibited the cranium of a Dicynodont reptile from the Cape Colony, which he regarded as new, and called it *Lystrosaurus frontosus*. The genus was near Ptychognathus, but differed in the horizontal shovel-like mandible received within the upper. The species was near the *Pt. latifrons* (Owen). but differed in the breadth of cranium exceeding the length, great interorbital width, prominent orbital tuberosities, very narrow front, &c. He exhibited specimens of more or less imperfect tusks from the Trias of Pennsylvania, which he referred to Dicynodont reptiles.—Prof. F. V. Hayden communicated an essay on the stratigraphy of certain tertiary rocks on the line of the Pacific Railroad, including, among others, a section of a remarkable anticlinal in the basin of Utah. The strata exhibited in this section embrace two hundred distinct layers, varying from two inches to four feet in thickness. At the eastern extremity they are vertical, at the western they are bent in the form of a bow. It is a remarkable illustration of an arch unaffected by heat that Dr. Hayden had seen in the West. Some of the layers were composed of fossil shells, among others, Unio, Paludina, Corbula, &c.; the species few, but the individuals numerous.

DIARY

THURSDAY, JUNE 2.

LINNEAN SOCIETY, at 8.—On some New Forms of Trichopterous Insects.
CHEMICAL SOCIETY, at 8.—On the Platinum Ammonias: Dr. Odling.
ROYAL INSTITUTION, at 3.—Electricity: Prof. Tyndall.

FRIDAY, JUNE 3.

ROYAL INSTITUTION, at 8.—Migration of Fables: Prof. Max Müller.
GEOLOGISTS' ASSOCIATION, at 8.

SATURDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Comets: Prof. Grant.

MONDAY, JUNE 6.

ENTOMOLOGICAL SOCIETY, at 7.
LONDON INSTITUTION, at 4.—Botany: Prof. Bentley.

TUESDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—Present English History: Prof. Seeley.
ETHNOLOGICAL SOCIETY, at 8.30 (at the Museum of Practical Geology).—On the Geographical Distribution of the Chief Modifications of Mankind: Prof. Huxley.

WEDNESDAY, JUNE 8.

GEOLOGICAL SOCIETY, at 8.
ROYAL MICROSCOPICAL SOCIETY, at 8.—Experiments on Fermentation and Parasitic Fungi: John Bell.—A New Form of Binocular Microscope: John W. Stephenson.

THURSDAY, JUNE 9.

ZOOLOGICAL SOCIETY, at 8.30.
MATHEMATICAL SOCIETY, at 8.
ROYAL INSTITUTION, at 3.—Electricity: Prof. Tyndall.

BOOKS RECEIVED

ENGLISH.—The Interior of the Earth: H. P. Malet (Hodder and Stoughton.)—The Modern Practical Angler; H. C. Pennell (Warne and Co.).—Primitive Man: L. Figuier (Chapman and Hall).—Water Analysis: J. A. Wanklyn (Trübner and Co.).—Rustic Adornments for Homes of Taste: Shirley Hibberd, new edition (Groombridge and Co.).—The Student's Flora of the British Islands: Dr. J. D. Hooker (Macmillan and Co.).

FOREIGN (through Williams and Norgate).—Die Pflanzenstoffe, zweite Lieferung: Dr. A. Husemann.—Précis de Paléontologie humaine: E. T. Hamy.—Die Gestaltung der Erdoberfläche nach bestimmten Gesetzen: O. Reichenbach.

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