THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE:

THE JOURNAL OF

THE POSTAL MICROSCOPICAL SOCIETY

AND

THE WESLEY NATURALISTS' SOCIETY.

EDITED BY

ALFRED ALLEN

AND

WILLIAM SPIERS, M.A., F.G.S., ETC.

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Preface.

THE present Part completes our NINTH VOLUME of THE JOURNAL OF MICROSCOPY (the Third Volume of the New Series). The first year of the amalgamation between the Postal Microscopical Society and the Wesley Naturalists' Society having drawn to a close, we are glad to be able to assure our readers that the arrangement has proved entirely satisfactory. The aims of the two Societies are so very similar that there can be no reason for their separate existence, while their union has enabled us to produce an enlarged and improved periodical. The circulation has considerably increased, although not to the extent that we had anticipated. We hope, however, that there will be a continued improvement in this respect as the new features of the Journal become more widely known.

We shall endeavour to furnish students of Science with popular and easy Articles on all branches of this department of knowledge, and to encourage in every possible way those who are wishful to master any special subject. The wants of young people will be steadily kept in view, while, at the same time, no pains will be spared to present the latest results of scientific research. We hope also to be enabled to effect still further improvements in our illustrations and lithographic plates.

Although strictly avoiding all sectarian differences and discussions, we yet desire to maintain a distinct alliance with the Christian religion, and thus to demonstrate the fallacy of the assumption that there is a necessary conflict between Science and the generally-received doctrines of the Bible.

Various important alterations are contemplated for the next year, of which full particulars will be given as soon as our plans are organised, and we venture to appeal to our constituency for continued confidence and support.

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"*Knowledge is not given us to keep, but to impart: its worth is lost in concealment.*"

To our Readers.

—o—

IT affords us much satisfaction to be able to announce that an amalgamation has been effected between our Journal and that of the Wesley Scientific Society. The President of this Society is the Rev. Dr. Dallinger, F.R.S., etc.—too well known in scientific circles to need any introduction to our readers. The organizing Secretary and Editor, the Rev. W. Spiers, M.A. (Lond.), F.G.S., F.R.M.S., who for some years has been a frequent writer on scientific subjects and was the originator of the Wesley Scientific Society, will be associated with me in the editorship.

This accession to our constituency will enable us to enlarge the Journal to 70 or 80 pages, and will also make it possible for us to provide additional illustrations and papers on various branches of Natural Science.

The general character and quality of the Journal will be maintained, and, we trust, improved.

We beg to express the hope that our contributors and subscribers will continue to give us their valuable help, and will do all in their power to extend the usefulness of the Journal.

ALFRED ALLEN.

The Cells of Mosses.

The Presidential Address,

By the Rev. W. H. Lett, M.A., T.C.D.

TO trace the life-history of a plant from its beginning as a single cell, up through the repeated divisions or multiplications of that vegetable cell, and the formation or growth of cell after cell, till the compound mass of cells known as cell-tissue, of which most plants consist, is reached, is one of the most interesting and important departments of botany. This is considered by most persons such a difficult matter that it is left almost entirely to those who delight in mastering the pages of Sachs' or similar works. But there should be no such insuperable difficulty, and there really is not, in the way of those who possess a good microscope and are endowed with a moderate stock of patience and enthusiasm. Without these there is not much use in a person taking up any subject of study—and Microscopical Botany is no exception. There are obstacles to be overcome, but diligence will effect that, and what knowledge is there of anything that is worth acquiring that is quite free from them? But some of the deterrents as regards vegetable biology are imaginary, while others dissolve when the task is attempted. And one of these latter is the supposed difficulty of getting suitable specimens of plants wherewith to carry on the needful investigations. Now, as the members of the Postal Microscopical Society are not supposed to know all about everything, my desire in this address is to point out that there is a vast store of objects admirably suitable for this purpose, commonly found almost everywhere, and at all seasons, and to recommend to the members of the Postal Microscopical Society the exploration of their wonders, and marvellous beauties, of cell form, structure, and composition.

Algæ, and especially those inhabiting fresh water, are most useful, and are often employed for the object in contemplation, but the Mosses or *Musci*, which are what I allude to, are of all tribes of plants the best adapted for studying how vegetable cells come into existence, increase in size, multiply, and reach maturity; because Mosses in all the early stages, and in many of the later conditions of their growth, are mostly of a semi-transparent nature, while they have this great advantage, that the various stages of growth can be found at every time of the year, and almost everywhere; to which is to be added, that nearly all of them have the peculiarity of reviving, as it were, after being dried, their cells taking up water the moment they come in contact with it, and swelling to their original size, even though the plant may have been kept perfectly dry for years. Owing to this, it is actually possible to intermit the study of the Mosses for a shorter or longer period, and that with the same specimen, and to resume it almost where one left off.

Thus we can start with the single cell of the germinating spore of a moss, and trace it up step by step through the protonema and the prothallium stages, till we find it developing into a little budlet of leaves, the beginning of the plant, of leaf, and stem, and branches, and capsule-crowned seta. For this purpose, specimens can be readily found in abundance in spring and early summer, on damp clay under trees, and the shady side of ditch-banks, and open field-drains, where the green stratum, covering the earth like a thick emerald cobweb, will usually furnish every stage of growth :—The single germinating cell; the tubular bulging of its inner coat; and its dividing transversely, as the cells multiply by the growth which takes place only at the apex of the filamentous shoot, or branch; and the origin of the buds which eventually develop into the leafy plant.

These protonema growths will furnish examples of complete cells, in which can be found, according to their age and development, these three parts :—1, The firm, elastic, outer, enclosing membrane, called the *cell-wall;* 2, The soft, inelastic, semi-fluid substance inside the cell-wall, called the *protoplasm*, in which is generally imbedded a more solid, rounded body called the nucleus; and 3, The *cell-sap*, which is a watery fluid occupying the centre. In the protoplasm will be found the chlorophyll granules or colouring grains, which give the green colour to vegetable or plant life. These will be found in varying quantity and of different dimensions in various mosses. They are especially large in the leaves of *Funaria hygrometrica* and some species of *Barbula;* while in *Bryum argenteum* a large proportion of the leaf-cells has no chlorophyll, which produces the shining, silvery appearance from which has been derived its distinguishing name. And again, others of the *Bryum*, *Hypnum*, and *Sphagnum* have such a small allowance of chlorophyll as to be partly transparent.

When we come to examine the combinations or aggregations of cells forming the tissues of which the mosses are composed, we meet with simple examples of the various ways in which they are united in various parts of mosses. Thus, what botanists call *cell-masses*, where the cells are united in all directions of space, may be found very distinct in the young or early stage of the sporangium, or urn, or fruit-vessel; and *cell-rows*, in which simple cells are in contact only at the opposite ends, exist in the early or protonema threads just referred to, and in the red radicles, which are produced more or less near the base of all mosses, except some *Sphagnums*, and with which the stems of some so abound as to felt them together; for instance, *Mnium hornum*, *Campylopus flexuosus*, *Breutelia arcuata*, and *Dicranella heteromalla*, and in the lamellæ on the upper surface of the leaves of *Polytrichum* and *Torula ericæfolia*. *Cell-surfaces*, where the component cells form a single flat layer, united in two directions of space, are illustrated by the leaves of most mosses, more particularly those of *Mnium punctata*, *Fontinalis antipyretica*, all the *Sphagnum* family, and *Hookeria lucens;* while fibro-vascular bundles of the simplest kind, the beginning of *cell-bundles* and the commencement of woody structure, can be discerned in portions of the stem of *Polytrichum* and *Bryum*.

Cell-groups, or families of similar cells, are found in the gemmæ of *Aulacomnion palustre* and *Aulacomnion androgynum*, *Orthotrichum Lyellii*, *Ulota phyllantha*, and *Barbula papillosa*.

Most of the Mosses afford ready subjects for studying the *walls* of tissue cells, nearly all without any preparation; while those which are dark and incrassated, like the *Andreæas*, can be quickly brought into a requisite condition by the application of a solution of caustic potash and water. The *Sphagnums*, *Pottias*, *Splachnums*, *Funaria*, and *Bryums* are admirably adapted for this purpose, while the first-named give the opportunity of studying some of the physical changes in the cell-walls of these exquisitely-curious and beautiful leaf-cells.

The *Sphagnums* also present examples of *intercellular spaces* or empty cells, which in a normal state of growth are filled with water, but when dry with air, to which is owing the glossy appearance of the whole family and the genus *Leucobryum*, when they are not in a moist condition.

Parenchymatous cells, or those which are more or less cubical, and where the length does not exceed the breadth, are found in the leaves of *Fisidens*, *Tortula*, *Polytrichum*, *Orthotrichum*, *Pottia*, and at the apices and bases of the leaves of many other mosses. While *Prosenchymatous cells*, or those in which the cells are always much longer than they are broad, the extremities tapering more or less, and overlapping each other, are found in the leaves of *Bryum*, *Sphagnum*, *Hypnum*, *Dicranum*, and *Campylopus*. Indeed, the *form* of the cells that exist in Mosses is so varied—as Schimper points out in the Introduction to his *Moss Flora*—that of itself it might afford a vast field of intellectual work to the ardent observer. Thus, as regards the cells of the leaves alone, there is very great variety. In *Orthotrichum* the cells are hexagonal, with the centre, as it were, pierced or punched out. In *Pottia* and others the cells are quadrangular and hexagonal. In *Bryum* and *Rhyncostegium* they are rhomboid. In many other *Hypnaceæ* they are hexagonal-linear. In the true Hypnums they are linear, often extremely long, vermicular, and flexuous linear; while they are sinuous and linear in *Grimmia* and *Andreæa*.

Mosses, also, afford excellent specimens for examining simple *epidermal tissue*, and that in variety and different degrees of perfection. It is most highly developed in the Sporogonium or fruit and its seta or stalk, the cells being small and comparatively firm and strong, as is also the case in the stems of *Hypnum*, *Bryum*, *Tortula*, *Dicranum*, *Campylopus*, and others; while it is just the opposite in the stems of *Sphagnum*, where the epidermal layers are composed of cells of a much larger and more delicate constitution than the cells near the centre.

There are many other points of similarity and contrast to be noticed amongst the cells of these lowly plants, and a vast field of study lies open before the diligent student. I shall add just one other fact. Among the contents of the cells of some Mosses have been found by several observers minute granules of *starch* lying embedded in the grains of chlorophyll, and also globules of *oil.*

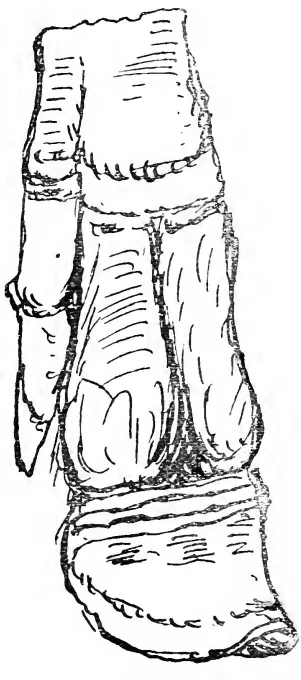
The preparation of specimens of the cells of mosses for examination under the microscope is indispensable. With fresh and growing plants pure water is all that is required ; but for preservation in the cabinet some *good medium* in which the specimen will be kept unaltered for years is to be desired. All those that have yet been used have serious drawbacks. Canada balsam and dammar make the moss-cell too clear and transparent. Anything in which there is glycerine effects too much alteration in the contents and walls of the cells ; while fluid mediums are, as we all know to our grief, most unreliable. Here, then, is an additional reason for me to recommend the study of the cells of Mosses to our members. A perfectly satisfactory and trustworthy medium for mounting Mosses as microscopic objects, so as to have their cells as they were when the plant was growing, is wanted.

SAPOSCHNIKOFF finds that sugar-cane can be transformed by the leaves into starch. In his experiments he placed plants of various sorts in the dark for a time ; then cut off some leaves and bisected each along the midrib. One half was tested for starch ; the other was laid for from four to eighteen days in a 10 to 20 per cent. solution of cane-sugar, and then tested for starch both with iodine and by Faulenbach's method. Starch was found in abundance, especially along the veins. When the lower end of a leaf of *Cordyline rubra* was dipped 5 mm. in the sugar, the leaf was black under the iodine test as far as 7 mm., from which point up to 10 mm. the colour gradually became less deep, but extended far along the veins. In variegated leaves only the chlorophyllous cells formed starch.

Solid-Hoofed Hogs.

By Mrs. Alice Bodington.

IN the present state of controversy as to the inheritance of parental peculiarities, the account in the *American Naturalist*, for May, 1889, of several well-authenticated instances of solid-hoofed hogs, is particularly interesting. The first instances of this new departure in the annals of pigdom were reported from Texas, in 1878. The breed was already "*so firmly established that no tendency to revert to the normal form was observable*, and in the cross of a solid-hoofed boar, with a sow of the ordinary type, a majority of the litter had the peculiarity of the sire apparent."



Foot of Solid-hoofed Hog from Louisiana.

Mr. Auld, the contributor of the paper, says, that a similar case had just been reported to him from Sioux City, Iowa. The owner seemed quite alive to the peculiarities of his pigs, and had been breeding from them for some time; he advertises them for sale, "not alone as curiosities, but, in a commercial sense, as a valuable production for mankind." They had suffered no losses from the diseases prevalent in the district for years past.

A correspondent of the *Rural New Yorker* not only writes from Cottonville, Louis., about these "mule-footed hogs," but very considerately sends a foot, as a curiosity which he had "never seen before, nor even heard of." An exact drawing of this foot has been made. The editor of the *Rural New Yorker* adds a note to this effect—"We have seen several of these 'mule-footed' hogs. In a small

Southern town, a large Poland-China boar had one hind foot exactly like the one shown in our picture, and a large proportion of the young pigs from him were marked in the same way." This recalls strongly to memory the celebrated Ancon ram, mentioned in the "Origin of Species," with his notable short legs, and the useful breed of short-legged sheep of which he became the progenitor.

The herd of mule-footed hogs, from one member of which the foot was sent, ranges the woods about eight miles north of Baton Rouge, Louisiana, and none of the old settlers could tell anything as to their origin, looking upon it simply as "a herd of wild hogs."

Dr. Coues observes that in the new breed "the terminal phalanges of the functional toes are united to form a single broad phalange; above this, the other two phalanges remain perfectly distinct. The hoof is perfectly solid, and on its sole there was a broad, angular elevation of solid substance, curiously like the frog of a horse's hoof." This formation of the parts of the feet is not only a new departure in the history of the old conservative family of the *Sus*, but is also (unless I am much mistaken) absolutely a new departure in the history of the whole sub-order of Paired-hoofed Ungulates. It shows also that Nature can effect her transformations, not by the slowest and most patient steps, but also by what, in our present ignorance of some of her guiding laws, we must still call "sports."

THE IMPORTANCE OF PHOTOGRAPHY IN RELATION TO MICROSCOPIC WORK.—M. Duchesnes, writing in the *Bulletin* of the French Photographic Society, very emphatically insists on the desirability of the microscopical student making use of photography in his work, and points out how well suited certain diatoms are for first trials in micro-photography. He especially refers to the siliceous skeleton of *Amphipleura pellucida* as an example of a diatom having remarkably delicate structure, and serving well as a test-object to measure the success of photographic illustrations.

Among the Sea-Urchins.

By Geo. Swainson, F.L.S.

Plate I.

A MOST curious and antiquated little spot is the hamlet of Cregneish, situated quite out of the world at the extreme south-western portion of the Isle of Man, on the hills overlooking the Calf of Man. We had sauntered up here from Port Erin to view the reputed birth-place of Professor E. Forbes, whose "Star-fishes and Sea-Urchins" is still the best descriptive work relating to our native species, though written 50 years ago. From this storm-battered, world-forsaken little spot in his young days Forbes had opportunities of seeing Nature in some of her grandest and wildest aspects, for not far away are two Druidical stone circles, close to those wonderful fissures called "The Chasms," some of which, from their great depth, the natives say, are bottomless, while a short distance from the shore, 400 feet below, stands the "Sugar Loaf" rock, rising upright from the sea, and peopled by innumerable sea-gulls, etc.; while to the right is that majestic breast work—"Spanish Head," where a number of the ships of the Spanish Armada were battered to pieces by the tempests there met with. So we can quite understand that the thoughtful boy reared near such a spot should become fascinated by the marvels of Nature displayed in such rich profusion around the shores of his sea-girt home. We could only stay a few days at Port Erin, but we were wishful to try a few of Professor Romanes' experiments on Sea-Urchins in a living state, as these creatures are to be found here in abundance, especially *Echinus sphæra;* the fishermen's cottages having them piled up, stripped of their spines, but in all their splendid colours and markings, offered for sale to the Manx tourists.

Port Erin is a land-locked bay, which, in such beautiful weather as we were favoured with, is a delightful spot to visit, sheltered as it is on both sides with lofty headlands, while the rocks at the foot of Bradda Head are prolific with all forms of marine life. Some of our rarest specimens were taken with a scallop dredge, but in one boating excursion, half way towards the Calf, we found a nice cave, which, as it was low water, we were enabled to enter and watch some of the finny inhabitants disporting themselves among the sea-weed. Thus we spent a pleasant hour, resting and watching the treasures of marine life here unfolded to our gaze, for the calmness of the water enabled us to see down to a considerable depth. On the sea-weeds bending under their weight, as well as on the rocks, were numbers of Sea-Urchins, travelling along by the aid of their sucker-feet and pedicellaria, for we had here evidence of the truth of Professor Romanes' suggestion as to the use of these latter. We saw one of them distinctly move from one large piece of sea-weed to another by the aid of these organs. Here were also Dead Men's Fingers (*Alcyonium digitatum*), large lobed pieces, bigger than a man's fist, pink, white, and orange colour, with their lovely tentacles fully extended, giving a most delicate and beautiful appearance, little deserving the ill-omened name bestowed upon them by the fishermen, who often bring them up in their nets.

The shape of the common Sea Urchin, with its armour-like covering and sharp spines, is well known, but surely there must be a good deal of interest in the construction of a creature about which the eloquent historian of the British star-fishes ventures to assert that "the skill of the great Architect of Nature is not less displayed in the construction of a sea-urchin than in the building up of a world." *

Taking up one of these hard shelly boxes, the superficial observer would naturally come to the conclusion that it is made all of one piece, formed by deposition of lime, like the shell of a mollusc, but if so, we are met with a puzzle more difficult to account for than the milk in the cocoa-nut, as to how the animal enclosed within is enabled to grow in size, for grow they do, as every gradation in size amongst our specimens proves. Minute inspection, however, shows that the shell is composed of hexagonal plates, more than 500 in number, all dove-tailed together with the neatest exactness, the whole outside shell being enveloped by a very thin muscular coat of living flesh, the endoderm of which secretes the calcareous matter formed round each

* Forbes' "British Star Fishes," page 153.

plate. As the confined creature feeds and grows in bulk, the pressure within would widen the seams, but each plate is gradually increased in size by the deposition of carbonate of lime round its edges, which thus gradually enlarge, increasing the bulk of the whole shell in an exactly equal ratio. There are 20 rows of these plates ranged in 10 alternate zones (*a* and *i*), with avenues of pores between (see woodcut, Fig. I., A and B). On each plate is seen the bosses or nipples, on which are fixed beautiful fluted or sculptured spines (E), which fit on these nipples, on the ball-and-socket joint principle, giving each spine a power of rotation in every direction. Each large spine is surrounded by smaller ones, while from the double row of pores proceed the ambulacra or tube feet. Forbes calculates that a full-sized urchin will carry on its surface at least 4,000 spines, while there will be 1,860 tube feet, each occupying two of the tiny holes.

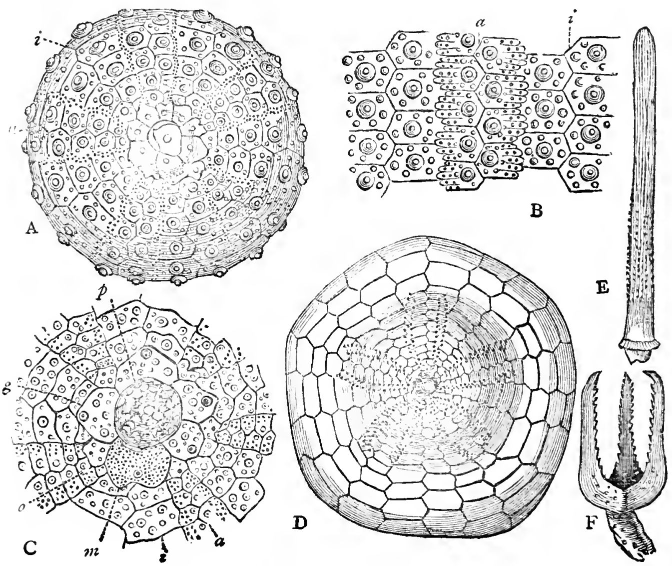


Fig. I. Morphology of Sea-Urchin.

It is really wonderful, when carrying on a series of experiments with these animals, to watch the co-ordination of action throughout the muscular coat, which lines both the outside and inside of the shell. The animal has command over each distinct spine, etc., either individually or as a whole, the prick of a needle bringing all the spines and pedicellaria, or nippers (Fig. 1, F), around the cause of irritation; while, if placed on a table, and a lighted match be held near it, the spines will move the entire body as rapidly as possible, away from it.

By various most interesting experiments Professor Romanes satisfactorily proved the existence of a nerve plexus in the organised membrane, which, in a tissue of exceeding thinness, passes between the sutures, where the plates come in contact with each other. Thus the animal within the shell has full command of the situation, although distinct independent action appears to be possessed by the pedicellaria and minute organs of touch distributed about the shell, especially some near the mouth, with tiny heads covered with cilia, which Loven supposes to be organs of taste.

The summit of the shell shown at Fig. 1, C, gives at *p* the membrane surrounding the anus, around which are the five "genital" plates, *g.*; one of these, larger than the others, supports a spongy tubercle, perforated by many minute pores (Fig. 1, C, *m*). This is the madreporic filter, by which the internal canals are kept supplied with the purest sea-water. Wedged between the genital plates are five smaller ones, long known as the "ocular" plates, shown at *o*, each of which can protrude from a small hole therein a curious little tentacle or feeler. The enquiry into the properties of this organ of sense has caused a large amount of diverse opinion, especially as to its possessing at its base an eye-spot, or organ of vision, which is now doubted by the highest authorities.

We very seldom found an Echinus left out of water by the receding tide, but sometimes this was the case, as we found during a visit to the rocks of Dalby, where that storm-beaten and dangerous reef, or headland—"the Niarbyl"—runs out to sea for so many hundred yards. We were boating and dredging around this point in deep water several times when there was a calm sea, our hunting being most successful round its precipitous sides. There, at low water, were most lovely Anemones of many varieties, disporting themselves in all their gorgeous beauty and wealth of tentacle, while amongst the crevices we now and then found an

Echinus left high and dry. He had evidently been hunting for prey, and had not calculated the depth of the receding tide, for the sucker feet are only available when under water.

The outside muscular coat is full of nerve-tissue of great power. This is especially seen in the Purple Heart Urchin (*Spatangus purpureus*), where the lower spines are very long, with which the creature is enabled rapidly to clear away the sand in every direction and quickly sink out of sight and danger. We took several of these handsome purple species one day when out with a fishing trawler. They are oval-shaped and rather flat in appearance, measuring from four to five inches in their longest diameter. The markings show very beautifully when the shell is cleared of its spines, etc.

We were also fortunate in securing two specimens of the *Brissus lyrifer*, which is also heart-shaped, with smaller spines, but having a most curious dorsal impression engraved on the shell, from which it is called the Fiddle Heart-Urchin. The figure of these hairy sea-eggs, as the sailors call them, is well shown in our centre illustration on Plate I., where one-half of the shell is denuded of its spines, in order to show the arrangement of pores, taking something like the form of a cross, from which the tube feet proceed. In *Spatangus* they take the form of a leaf, as they are similarly arranged in the centre of *Clypeaster* (Fig. 1, D).

The small Heart Urchin (*Amphidotus cordatus*) inhabits the sand at the bottom of the sea in our shallow bays. It is very often found thrown up by the receding tide along the shores at Blackpool and Southport, appearing white and very brittle when thus bleached and denuded of its spines; but a perfect specimen is sometimes found covered with its hair-like spines, which vary in form. They are all very slender and curved, some being flattened towards the tip, the whole appearance being very silky and glittering when dried. We will take up one of these sea-eggs denuded of its spines, and minutely examine it with the microscope with reflected light. The bosses or tiny nipples shine with sparkling brilliancy like polished glass. The under-part of the shell appears to be covered with a beautiful network of curved oval pits or little depressions which surround these glassy knobs. This is a beautiful provision of Nature, giving the thin muscular flesh, with which the body is covered, a better purchase, or pushing power, to enable the creature rapidly to disappear beneath the sand; for the muscular bands, which—holding the spines firmly in their position above the glassy nipples—are enabled to move the spoon-shaped spines with a powerful outward stroke, wherewith the sand is shuffled away from the bed. Each spine is covered for some distance above the "ball-and socket" joint with a thin muscular coat full of ligamentous bands. This coating entirely covers the minute spines, to which are attached those curious little appendages called "*Pedicellariæ*" (Pl. I., Figs. 6, 7, 8, 9, and 10), which are fixed upon highly-organised membranous stalks, which move about like the neck of a swan, but are highly contractile (Figs. 6 and 10). These organs were originally supposed to be parasites upon the Urchin, but they are now known to act in the way of support to the Echini by seizing hold upon sea-weeds, etc., with their triangular blades or nippers, until the sucker feet of the Echinus have had time to press and attach themselves. When alive, these blades act apparently independently of the will of the animal, for they are constantly opening and closing. Sometimes they are lengthened out and their edges serrated with teeth (Fig. 9), which fit and lock into each other with exquisite precision instantly a thread or leaf of algæ touches them. They vary greatly in form, as may be seen in our illustration (Plate I., Figs. 7, 8, 9, and 10, and Fig. 1, F). Another function they have also been noticed to perform in some species is the removal of excrementitious particles when ejected from the vent. These interesting little organs have been a constant source of investigation and puzzle to naturalists for over fifty years. Professor Louis Agassiz originally thought them "infant Echini, which, after their exclusion, affix themselves to the skin of their mother." When denuded of their integument and muscle by boiling in liquor potassæ, they form one of the most beautiful microscopic preparations, especially when examined with the polariscope and selenite plate, the texture being remarkable for lightness and porosity, being formed of a net-work of interspaces freely communicating with each other (Pl. I., Fig. 8); in fact, the whole texture of the Echinus shell is made up of calcified areolar tissue (highly magnified in woodcut, Fig. 2, B), for which every hard portion of the sub-kingdom Echinodermata is so specially noted, even if we examine a fossil Echinoid from the antique Ordovician period. The spines, when cut in thin sections, form beautiful and well-known polariscopic mounts, the spine of each species being formed on a different design. One of the thickest spines is that from *Cidaris papillata;* a segment from a slice of which is shown at Plate I., Fig. 11.

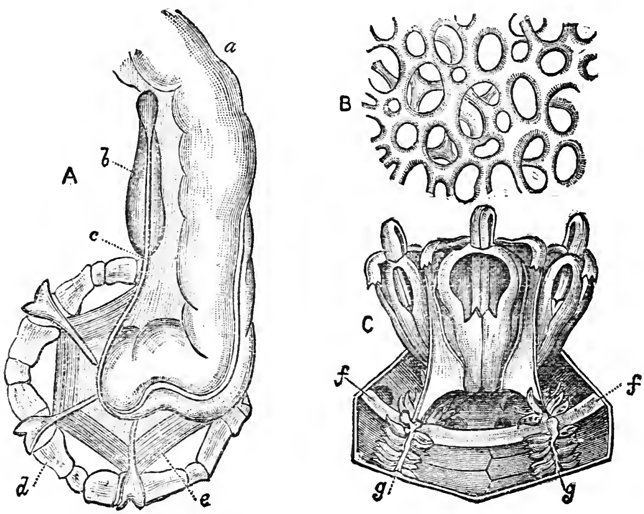


Fig. 2. Masticatory Apparatus of Echinus.

We must now deal with the other principal organs of locomotion in the Sea-Urchin, namely, the "ambulacra," or tube feet, whereby this round ball is enabled to mount the sides of a sub-marine precipice, or traverse the frond of a moving sea-weed. These are the long waving tubes which are so noticeable on a star fish or Echinus when out of the water. One of these ambulacral suckers is connected with each pair of tiny holes seen in woodcut (Fig. 1, B), through which every tube communicates with the interior of the shell. Within the Echinus there is a marvellously interesting water vascular system, which ramifies throughout its inner circumference, being connected with the madreporic filter (see woodcut, Fig. 1, C, *m*), from which a plentiful supply of water is available at all times, being conveyed to a circular tube round the mouth, (Fig. 2, C, *f*), from whence proceed radiating canals along the ambulacral areas, which are connected with the tube feet. The circular canal also supplies five special membranous sacs or bladders, called the "Polian vesicles," which act as reservoirs to receive the water when it is suddenly expelled from the tube feet. Each tube foot is divided near its base, one portion passing through one pore into the radiating canal, and thus on to the circular canal round the gullet with its reservoirs, while the other portion passes through the other pore into a small contractile vesicle, which, like the tube foot itself, is provided with rings of muscular fibre. These tiny bladders, or "Ampullæ," as they are called, can be seen in our woodcut (Fig. 2, C, *g-g*), on the inner side of the shell. When the muscles of these reservoirs contract, the contained fluid is driven into the tube feet, which are then protruded; and similarly when these muscles relax, the pressure is diminished, and the tube foot retracts. Similar muscular action takes place on a greater scale with the large "Polian vesicles," "a mechanism," says Professor Romanes, "of special interest, as being unique in the animal kingdom, for the animal is thus furnished with the means of varying the head of pressure in its tube feet, either locally or universally."

We were most interested in the evenings during our visit to Port Erin with our investigations into the structure of the tube feet, and the singular way in which the muscular fibre is strengthened by the addition of curious calcareous spicules within them. Our sponge investigations had made us very familiar with various forms of calcareous and siliceous sponge spicules, but we had never previously heard of these forms, and possibly many of our readers may hear of them now for the first time.

The beautiful calcareous rosette which forms the suctorial disc at the end of each tube foot was well known (see Plate I., Fig. 2), having been fully described by the late P. H. Gosse in his "Evenings at the Microscope":—"A glassy plate of extreme thinness, circular in form, lies free in the swollen cavity of the termination of the tube. It is cut into four or five incisions, which reach almost to the centre, which is perforated with a large round orifice." He then states that the marginal notching seen on the edge is not real, but apparent only. In this he is in error, for if the tube foot is entirely dissolved in caustic potash the rosette

Sea-Urchins

is found to be composed of plates varying from 5 to 8 in number, distinctly notched on the margin in a most beautiful and regular design (see Plate I., Fig. 3), full of numerous cavities. These plates are held together in position by a calcareous ring of other oblong plates (Figs. 4, 13. and 15), while the walls of the tube feet are filled with the curious "C"-shaped spicules, shown at Figs. 16 and 18, which closely resemble the sponge spicules obtained from *Desmacidon incrustans*.

It was when partially reducing the muscular fibre of the tube feet, with a view to obtain a few perfect microscopic mounts, *in situ*, of the calcareous rosette, that we were surprised to meet with these spicules, which vary greatly in size and shape, and which neither Gosse, Forbes, nor any other popular English writer that we have met with appears to have ever noticed. The American Professor Alex. Agassiz, however, fully describes them in his "Revision of the Echini," 1874. Like the sponges, each distinct species has its own peculiar form, some of which are drawn in Figs. 12 to 18; those of *Echinometra*, shown at Figs. 17 and 18, being very remarkable.

We have not yet recounted all the wonders in connection with the Sea-Urchin, but an account of the digestive system (see woodcut, Fig. 2, A), and a description of the mouth (Fig. 2, C), which is, perhaps, the most complex in nature, as also the history of the development of the urchin, from the larval form (Pl. I., Fig. 5), must be left for a future paper.

EXPLANATION OF PLATE I.

Fig. 1.—Sea-Urchin, *Brissus lyrifer* (Forbes), with half body cleared of spines, etc., to show ambulacra and fiddle-shaped dorsal impression.

,, 2.—Portion of Tube-foot of *Echinus sphæra*, reduced in liquor potassæ to show "C"-shaped spicules and calcareous rosette (ambulacral disc).

,, 3.—Single plate from ambulacral disc of *Echinus sphæra*.

,, 4.—Plate forming a portion of the calcareous ring round centre of rosette.

,, 5.—Larval form of Sea-Urchin.

,, 6.—Pedicellaria of *Spatangus purpureus*, with muscular stalk.

,, 7.—The same, with blades partly open.

,, 8.—Skeleton of Head of *P. tridens* from *Echinus sphæra*.

Fig. 9.—Head of *Pedicellaria globifera*, with teeth interlocking.
,, 10.—The same, from *Echinus miliaris*, with fleshy stem and blades fully open.
,, 11.—Segment of Section of Spine of *Cidaris papillata*.
,, 12 to 18.—Calcareous spicules found in ambulacral tube of *Arbacia pustulosa*, *Echinometra*, and *Strongylocentrotus*.

Sensibility.

By F. W. Sutcliffe, F.R.M.S.

IT is a curious fact, that however important or interesting a subject may be, it loses its piquancy when it becomes a matter of common occurrence. So it is with the subject of sensibility. Wrapt up and lost in the general intricacies of every-day life, many persons scarcely, if ever, give it a passing thought, although there is, perhaps, no subject more wonderful or instructive than this subject of sensation and thought. It is not our intention to enter into any elaborate examination of the subject in the present paper, but only to refer to one or two considerations which have a direct connection with it.

First of all, the question arises as to what branch of science our subject properly belongs. On this point alone many a fierce controversy has waged, some philosophers arguing that it can only be studied from the psychological standpoint, whilst others state that in reality it belongs to both the psychological and physiological branches of science. Be that as it may, we are inclined to think that the latter statement is the best and perhaps the most correct. Psychology is the science of the mind; physiology the science of life and its functions; and how far the two may be united is not for us to determine, but remains as a tough problem for philosophers.

Suffice it to say that, if we study this subject with determination, we shall succeed in solving, to a great extent, some of the mysteries connected with the nervous centres of life in spite of their complexity. At least, we shall find that beneath this complexity there lies a series of simple laws and common principles easy of comprehension, and not more formidable than the elementary properties we find underlying all forms of vitality.

But we must ask ourselves, What is meant by this term, Sensibility? It would appear that sensibility is that property by means of which living cells are brought into contact with surrounding media, and which, being cognisant of the impressions made by such media, reacts in a marvellous and specific manner.

Sensibility shows distinctly the two features of like and dislike, attraction and repulsion, absorbing with satisfaction the agreeable things of life, repulsing with repugnance the disagreeable. Luys says that sensibility is perhaps itself, in the organic world, only the transformation of those blind forces which attract among themselves the crystalline molecules of the inorganic world, and group them according to their proper affinities.

Sensation is, indeed, one of the most wonderful parts of being, and has solicited the attention of philosophers in all ages, presenting at times problems alluring, but at the same time baffling, and frequently overthrowing many preconceived ideas concerning it. As we have previously stated, there has at times been a difficulty in deciding into which branch of science it should be placed, for feeling and thinking, though more closely related to psychical science, are nevertheless intimately associated with the ordinary functions of everyday life. At first sight, one would be apt to say that the science of the mind is its proper sphere, but the difficulty remains as to how it can be dissociated from the science of function. Certainly, many do attempt to study the mind apart from any considerations connected with physiology; yet such a study must, in the long run, prove very inadequate, for the nervous system, being the instrument from which are evolved those mysterious impressions which produce the reflex actions we are all familiar with, must of necessity be first fully examined and understood before entering into any considerations as to their action. Then the great task remains of ascertaining the peculiar connection between sensation and the nervous system itself. Psychology and physiology by no means clash, for scarcely can they be profitably considered apart. Physiology by no means pretends to unravel the mysteries of psychology, yet physiology has made it possible to undertake a definite science and system of vital phenomena with respect to the nervous system; and by means of physiology alone there has arisen, according to Prof. Huxley, a vast province of orderly mystery derived from the region of disorderly mystery, which is the domain of ignorance.

When we speak of the nervous system, we include, as a matter of course, the brain, though many scientists delegate such to special and particular spheres. The brain is popularly considered as the sole organ of the mind—the one particular centre of sensation; whilst the rest of the nervous system has been ignored. Why this should be so is more than we can tell, especially after the numerous experiments carried out on a variety of creatures by different persons at different periods. All the nervous matter appears to be similarly constituted, and it scarcely seems reasonable to limit the constitution of mind as being the sole outcome and operation of the brain. Rather let us say that all sensation, thought, volition, etc., ought to be included in such a term.

On these points, however, we must not dwell, hoping to take them up in some future paper. In a former paper, in the *Wesley Naturalist*,* I dealt at large with the subject of the five special senses, and I therefore need here do no more than remark that such senses, awakening as they do a variety of phenomena in the sensorium proper, constitute, in fact, part of the motive power required for the generation of our ideas. Sight, hearing, and perhaps touch, awaken not only our ordinary sensibility, but may affect the emotional capacity of man to a great extent. Scenes may be recalled by the sight of some particular object or place which not only awakens a recollection of the place and event, but actually reproduces the joy or sorrow exhibited on the first occasion. These impressions, coming first through the vision, may prove and mould the emotive capacity of man after a specific fashion. Similarly with the tactile and olfactory nervous elements; but the phenomena of smell and taste, though affecting our general sensibility and proving themselves to be part and parcel of a general sensation, yet do not proceed to the seat of inner consciousness so as to awaken any sense of an emotive nature. Such nervous forces may be indeed stored in the sensorium proper, and even awaken reminiscences of former things and cause our judgment to infer this or that; but in themselves they are scarcely powerful enough to proceed to greater depths. All

* See *Wesley Naturalist*, Vol. III., p. 103.

our specific senses appear in the aggregate to have some connection with our general sensibility, and a most interesting study it would be for all students of psychology to investigate this subject.

Another interesting branch connected with sensibility is to study the evolution of this mysterious force or phenomenon. Beginning with the minute organisms of plant-life, we naturally press on into the higher regions of animal organisms, studying, as we proceed, the action of unicellular matter, and observing the gradual expansion of sensibility as we ascend in the scale of life. The conglomeration of cells, the division of labour, the appearance of special function, are all noteworthy. Then, from unconscious sensibility, we proceed to conscious sensibility, eventually finding ourselves landed in the mysterious region of a human brain. Very interesting and instructive it is to begin with the sub-kingdom *Mollusca*, taking, for example, the Ascidian of the type *Tunicata*, whose life-relation with the external world is very simple indeed, the nervous system being very rudimentary and consisting of simple small ganglia, which receive branches of nervous filaments from the tentacles that guard the orifice of an oval-shaped funnel, giving off outgoing filaments to various parts of its muscular sac, to the alimentary canal, and other internal organs. In this low form we have also those pigment cells in which a rudimentary visual function is supposed to exist, being situated in very close relation with the solitary ganglion. We pass along to the Brachiopods, which are amongst the oldest and most widespread representatives of the group to which they belong. They are very similar to the *Tunicata* in their visual organisation, which is somewhat complex, yet no definite sense-organs have been detected.

Ascending the scale we get amongst the Lamellibranchs, which appear to be the most complex mollusca known. Their sense-organs being keen and highly-developed, they are endowed with remarkable powers of locomotion. Some of the special senses are undoubtedly represented amongst the headless Mollusca. Thus, the *Pecten*, *Pupa*, *Spondylus*, and *Ostreæ* are in all probability possessed of tactile appendages. The functions found in such organisms are distributed in a remarkable manner, though such animals are brainless as well as headless. Pteropods constitute a kind of link, leading us from comparatively sluggish Lamellibranchs to Gasteropods and Cephalopods, organisms possessing distinct heads with sense-organs, and more or less developed brain. The nervous system of the Gasteropods is better developed, more complex, and concentrated. The Cephalopods stand considerably above all other Molluscs, the sensory organs being developed to a high degree.

Nothing distinctly answering to a brain is to be found in many of the lower animals in which nervous systems exist. Thus, in the Star-fish and large Nematoid Entozoa, what most resembles such an organ consists of a mere band of nerve-fibres surrounding the commencement of the œsophagus. Among the representatives of the sub-kingdom *Vermes*, the nervous system varies a good deal in minor details. The broad features are, however, comparatively similar in all.

Without pursuing the subject as to detail, we have said quite sufficient to show how interesting are the steps which lead from the simple forms of sensibility on to its most complex stages; and perhaps at some future time we may attempt to deal with the other aspects of this very fruitful branch of psychological science.

THOSE who have used the paraffin embedding method for serial sections have, doubtless, wished for some simplification of the process of staining. This may be done, according to Dr. Kúkenthal, by dissolving the colouring matter in absolute alcohol and dropping the solution into turpentine until the desired depth of colour is secured. Sections fixed to the slide with the collodion are kept in the oven until the clove-oil has completely evaporated, the paraffin dissolved in turpentine as usual, and the slide brought into the dye. The staining is quickly effected. Overstaining may be corrected by placing the slide for a short time in a mixture of acid-free, absolute alcohol and turpentine (equal parts). Turbidity of the colouring fluid may be corrected by adding a drop or two of alcohol. Meyer's carmine, methyl-green, methyl-blue, gentian violet, safranin, eosin, fuchsin, tropæolin, and malachite-green may be used in the above way.

Dips into My Aquarium.

BY THE REV. WILLIAM SPIERS, M.A., F.G.S., F.R.M.S., ETC.

I.—DESMIDS AND VOLVOX.

IN a corner of my study near a window stands a small fresh-water aquarium. Sometimes it is inside the room, and, in fine weather, it is placed outside on the sill. It is furnished with the gatherings of many rambles. Equipped with stick and bottles and net, I have, as opportunity has served, made my way to ponds, ditches, and canals, and after some rather dirty but most delightful fishing, have brought home all sorts of small fry and uninviting-looking mud. Tangled water-weeds, floating scum, prolific duckweed, dripping bog-moss, bedraggled reeds, and rushes; anything and everything that could be hauled out and squeezed into my jars, have been promiscuously collected, and after a cursory examination and rough clearing, tossed into this miniature world, which is bounded on the north, south, east, and west, by glass.

Having a tolerably wide circle of friends and acquaintances among whom I am generally regarded as having a craze for this sort of occupation, and some of whom no doubt frequently make merry at my expense, I am not often at a loss for suitable companions to whom I may exhibit my captures. Bored with my prolix descriptions they no doubt sometimes are, but I am not infrequently rewarded by observing how my visitors will catch my enthusiasm, and take fire from my fervid expositions of the wondrous beauties of almost invisible plants and animals which my pipette now and then brings up out of the grimy water of that rather unattractive aquarium.

I propose, in a few simple, non-technical papers, to describe to my readers some of the more easily-obtained organisms which I have been able to secure in this way, and which every beginner with the microscope is sure, before long, to become acquainted with. And here I may say that I shall rarely have anything new to relate to those who are accustomed to work of this kind, for I intend to write these papers exclusively for younger and comparatively inexperienced observers. I am continually hearing it affirmed that writers on scientific subjects never seem to think that students of nature must begin at the beginning, and that by plunging all at once into the intricacies and technicalities of zoology, they usually repel the enquirer, and lead him to the conviction that all natural science consists of nothing but dry facts and hard names. There is perhaps some truth in such remarks, but on the other hand it should be borne in mind that while it may be well to try to make the alphabet of knowledge attractive, yet the marvels of Nature can be fully appreciated by those only who are willing to take some trouble to study them accurately and systematically.

Let us now take a dip into the aquarium and see what will come up. Selecting a minute portion of the jungle-like mass of water weeds, I place it in a small glass trough, or in the live-box. Having fixed the one-inch objective in position, I lay the trough on the stage of the microscope, and proceed to focus the lens. In a moment or two all is in readiness for the inspection of my visitors. And what a spectacle it is which they gaze upon! It will not be very long before all sorts of ejaculations and expressions of amazement and delight will be uttered. All round the field, and interlacing every part of it, are microscopic water weeds (Algæ), while clinging to what look like thick stems and silvery twigs, or darting about through the microscopic jungle, are weird and wondrous creatures, which rivet the attention of the observer. In these few drops of water, in which to the naked eye there seemed to be almost nothing, there is now seen to exist a crowded population. There is the exquisitely beautiful Bell-animalcule (*Vorticella*), the elaborately organised Rotifer, or Wheel-animalcule, the Hydra, hanging on to the white root-fibre of the Duckweed (*Lemna*), with its tentacles spreading out like a tuft of branches, the whole not very dissimilar in appearance to a miniature palm-tree; while here and there, flitting about with extraordinary velocity, may be caught a glimpse of the slipper-shaped Paramœcium, the pink-eyed Euglena, or the restless Water-flea, which keeps up its incessant evolutions, like an untiring acrobat. But all these wonders cannot be fully described in the comparatively short space of time that my friends can give me at one visit. I proceed, therefore, to single out two or three of the objects seen, and separate them as far as possible from the rest.

We will confine ourselves at present to the minute vegetable organisms contained in the selected drop of water. The one-inch objective has given us a magnification of about 50, but now let us turn the nose-piece round and bring the $\frac{1}{4}$-inch lens into position. This is a glass constructed by the eminent opticians, Messrs. Powell and Lealand, and it will give a magnification of over 300 with the B eye-piece of Ross.

The first of these microscopic plants to which I shall draw attention is a Desmid. Here is one, of which an illustration is given (Fig. 1), called *Closterium*. It is a familiar object, but in this case familiarity does not breed contempt. Being of a bright green colour, and full of chlorophyll, which requires the action of sunlight, it follows that the proper time for collecting Desmids is during Summer and Autumn, and they are generally found near the surface of the water, where the sun can get at them.

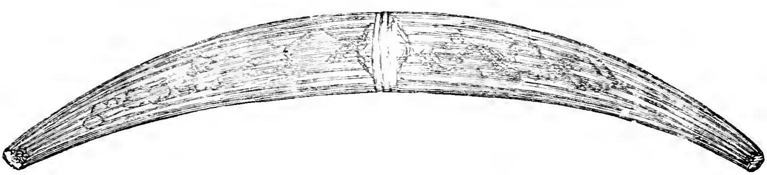


Fig. 1. Closterium striolatum.

These pretty little plants lie almost at the very bottom of the botanical scale. They belong to the natural order Algæ, of which sea-weeds are the best known types. But they are one-celled Algæ, and, as individuals, are invisible to the naked eye. They are exclusively fresh-water organisms, and are never found in the sea. In this they differ from their allies the Diatoms, which thrive in both fresh and salt water. My experience leads me to the conclusion that they are most easily found in shallow ponds on open moors, and on damp bog-moss. If a bit of this bog-moss (*Sphagnum*) feels slimy to the touch, the probability is that we have come upon a crop of Desmids. When found, it is as well to wash them into a glass bottle filled with clean water, where they will soon settle on the sides and bottom, from which they should be detached by a camel's hair brush, and deposited on a slip of glass for inspection. Most Desmids are free cells, but in some cases several individuals are grouped together in the form of a star or disc. Others, again, take the form of long threads or ribbons, and are consequently called filamentous Desmids (*e.g.*, *Hyalotheca*).

Desmids possess a transparent, membranous envelope or case, entirely destitute of silica, the flinty material which accompanies diatoms. This case contains the chlorophyll, or green colouring matter, which renders these tiny plants so conspicuous. They no doubt constitute the chief food of fresh-water animalcules, and almost every observer of them has seen the rotifer greedily suck out the contents of the envelope and cast away the empty, but still beautiful case. While living they have the power of gliding through the water with an even, graceful motion, while their hyaline covering, sparkling with emerald points and filled with diamond-like granules, make up a vision of beauty surpassing that which Aladdin's lamp revealed.

What gives to the plant this power of independent movement? Does it possess tiny hairs, or cilia, with which it lashes the water, or rows itself along, or is the cause to be found in the generation and exhalation of oxygen? Here is a question which I have to confess I am unable to answer, although I have peered at these fairy-like organisms with prolonged and tireless curiosity through almost the best optical apparatus that science can supply, and I could wish my readers no better fortune than that they might hit upon this well-guarded secret of Nature. For those who possess good appliances, I would suggest this problem for their study. The Desmid should be carefully observed on a dark back-ground, with and without a condenser, in a natural condition, and also stained with aniline dyes. But these are details into which I have promised not to enter now.

It is not difficult to cultivate Desmids. They should be kept in a watch-glass, filled with their own native water, and covered with a plate of glass to keep out dust and prevent too rapid evaporation. If absolutely necessary to renew the water, a little rain-water should be added.

There are two methods by which Desmids reproduce themselves. The first is by cell-division, or fission. The clear space in the centre of the Desmid may be seen gradually enlarging, without, however, the fracture of the membrane. In the course of two or three hours the two halves are separated, each commencing to grow, and continuing till the parent form is reached. Another method of reproduction is that called conjugation. Two individuals approach each other, and at length mingle their contents together, after which a circular body makes its appearance, called a sporangium—that is, a spore-vessel. At length a cloud of spores is poured out, and from them a multitude of Desmids ultimately develop.

Unfortunately, no medium has yet been discovered in which these lovely objects can be preserved as mounts so as to retain their colour. Hantzsch, of Dresden, has got as near to this desirable end as anyone, but complete success has never been attained. He used a mixture of pure alcohol, distilled water, and glycerine, which being nearly of the same specific gravity as water, retards the contraction of the cell. I have had several specimens in my cabinet for some years which have not appreciably altered. But even this method of mounting does not meet the difficulty of providing a perfectly air-tight cell, which is of course absolutely indispensable to the prevention, for an indefinite period, of evaporation.

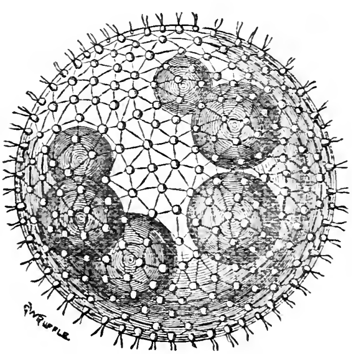


Fig. 2. Volvox globator.

Another object now claims our attention, and is one that will richly repay careful inspection. This is the ever-beautiful Volvox, familiar enough, but enshrining deep mysteries that even the restless eagerness of nineteenth-century science has not solved. It is an object well worthy of being sought after, and, fortunately, it can be obtained at almost any time in the year. It is, however, somewhat fickle in its attachments, for in localities where it has been found repeatedly, it will at another time be sought in vain, although there is apparently no reason for its disappearance.

Now, look at it through this half-inch objective. Did you ever see anything more lovely? Watch that gracefully-rolling sphere as it slowly revolves on its axis across the field of view; notice its delicate tracery, forming the boundary-lines of six-sided cells; observe the profusion of pear-shaped dots, from whose apices are projected those very fine gossamer-like hairs, or cilia, which penetrate right through the outer envelope and with swift movement row the Volvox along, and tell me whether even Nature's casket contains any gems more wondrously fair. Within the globe are smaller globes. With a higher magnification these are seen to be growing Volvoces, and not infrequently there may be found within these a third generation, all carrying on their marvellous gyrations within the parent-cell. After awhile, the mother, or the grandmother, will grow weary with age and cease her activities. She will lose her fresh greenness and perish; and the young, panting for liberty, will break through her ruptured sides and escape into the tiny water-world where they were born.

Under still higher powers, and with the help of a weak staining agent—such as iodine and diluted sulphuric acid—it will be seen that the green spots are united by extremely fine protoplasmic threads, which pass through the sides of the hexagonal cells. There may also be detected minute atoms of colourless protoplasm, which is probably the agent of cell-division. When the cell is ripe, it opens without abruptness as if there were a natural vent which is gradually prepared for this crisis, and the ensphered young glide out. At first, they are tied to the parent by long filaments, which prevent revolution; but soon the threads give way, and the sweets of perfect liberty are tasted. Whether there is actual revolution of the young within the parent globe, or whether the apparent revolution is due to an optical illusion caused by the motion of the mother-cell, is a point on which authorities differ, and is one about which I am not prepared to pronounce dogmatically.

There is, however, another reproductive process which may be witnessed in the later part of the year. Two distinct kinds of cells are developed within some of the larger globes: the one an egg-sphere (*oosphere*), and the other a sperm-sphere (*antherozoid*). In higher plants these correspond to pollen and ovules. The egg-spheres are fertilised by the antherozoids, and a kind of spore is the result. These escape from the decaying parent, and lie dormant till their vitalities are quickened by returning Spring, when they will at once start upon their new career and develop into perfect volvoces, endowed with the powers essential to cell-division.

(*To be continued.*)

THE FLAPPING OF A FLY'S WINGS.—The slow flapping of a butterfly's wing produces no sound, but when the movements are rapid a noise is produced which increases in shrillness with the number of vibrations. Thus, the house-fly, which produces the note F, vibrates its wings twenty-one thousand one hundred and twenty times a minute, or three hundred and thirty-five times in a second; and the bee, which makes the note A, as many as twenty-six thousand four hundred times, or four hundred and forty times in a second. On the contrary a tired bee hums on E, and, therefore, according to theory, vibrates its wings only three hundred and thirty times in a second. Marey, the naturalist, after many attempts, has succeeded, by a delicate mechanism, in confirming these numbers graphically. He fixed a fly so that the tip of the wing just touched a cylinder, which was moved by clock-work. Each stroke of the wing caused a mark, of course very slight but still quite perceptible, and this showed that there were actually three hundred and thirty strokes in a second, agreeing almost exactly with the number of vibrations inferred from the note produced.—*Sir John Lubbock.*

Some Recent Developments of the Doctrine of a Contagium Vivum.*

By R. Shingleton-Smith, M.D. Lond., B.Sc., F.R.C.P.,
Hon. Fellow of King's Coll., London.

Plate II.

THE existence of a *specific virus* as the cause of various contagious diseases has long been accepted as a fact; the influence of such a virus upon living bodies we call *Infection*, and the respective diseases receive the name of *Infectious Diseases.*

The transmission of disease, whether immediate or mediate, constitutes contagion—*i.e.*, the communication of disease from one person to another, either by contact, or through some medium (air, water, etc.). The term *contagion* is usually applied to the property of transmission, whilst the term *contagium* is applied to the virus itself. The term *infection* is therefore a synonym with *contagion*: both terms relate to specific diseases, always the same, except in degrees of virulence, and communicated by varying degrees of contact, mediate or immediate.

The Zymotic or Enthetic diseases (εντιθημι, I put in) are a large class produced by inoculation or implantation from without, and never arising spontaneously. The infecting agent has not certainly been known, and various theories have been brought forward concerning the nature of the poisons; of these, the so-called parasitic theory has found almost universal acceptance, and the doctrine of a *contagium animatum* has been regarded as assured, even although the actual contagium could not be microscopically demonstrated.

The observed laws of the contagious process have taught much as to the nature of contagion in general, and have shown that the phenomena of the dissemination of the contagium correspond to growth, as of some living thing.

"The various specific matters which effect contagion in the living body, the respective contagia of the given diseases, seem

* Read at a meeting of the Bristol Microscopical Society Nov. 14, 1889.

Section of Tuberculous Lung
X 1000
Stained
From a Photograph

all to have this one characteristic: that in appropriate media (among which must evidently be counted any living bodily texture or fluid which they can infect) they show themselves capable of self-multiplication, and it is in virtue of this property, that, although at the moment of their entering the body they in general do not attract notice either as objects of sense or as causes of bodily change, they gradually get to be recognisable in both of these respects. Now, the faculty of self-multiplication is eminently one of the characters which we call *vital;* and, when it is said that all contagia are self-multiplying things, this is at least very strongly to suggest that perhaps all contagia are things endowed with life" (John Simon).

Again, it has been pointed out that the distribution in place and time of specific infectious diseases follows the same laws as the distribution of organised beings. "Climate and physical conditions do not produce specific diseases. The origin of these is as obscure as the origin of species; their migrations are explicable by the same laws as those of organised beings, and they often accompany, like domestic animals and plants, the migrations of man." (J. F. Payne.)

It is only during the last ten or fifteen years that the existence of micro-organisms as causes of disease has been definitely proved, and it cannot now be doubted that a contagium vivum is an actually demonstrated reality. In the case of a good many diseases the proof is still wanting, but analogy indicates that many of the actual contagia, not yet discovered, will ere long be definitely described.

It is not a little remarkable that the two diseases, in which a definite visible Bacillus has now been proved to be the one essential factor in their production, should not be universally admitted to be contagious. The bacillus of tubercle is now well-known to be invariably present in tuberculous products, and the bacillus of leprosy is an equally constant element in leprous tissues; and yet these two diseases are not commonly included amongst the Enthetic class, whereas, in few of the ordinary contagious Exanthemata has a definite living contagium been discovered. No one doubts but that the list of demonstrable pathogenic bacteria will gradually be added to, but we are already familiar with a pretty long list. Amongst the diseases of animals we have Chicken-Cholera, Charbon, Pig-Typhoid, and the Silk-worm disease. Amongst human diseases we have Anthrax, Erysipelas, Septicæmia, Typhoid Fever, Relapsing Fever, Malarial Fever, Cholera, Lepra, and Tuberculosis, in all of which the specific character of the observed micro-organisms is now admitted.

The list of Enthetic diseases given by Dr. Hartshorne, in Pepper's System of Medicine, is as follows:—

1.—Only produced by contact or inoculation:—

Primary Syphilis,	Vaccinia,
Gonorrhœa,	Hydrophobia.

2.—Contagious also by atmospheric transmission through short distances:—

Variola,	Scarlatina,
Varioloid,	Rötheln,
Varicella,	Mumps,
Measles,	Whooping Cough,
Diphtheria,	Typhus,

Relapsing Fever.

3.—Endemic, occasionally epidemic:—

Malarial Fever, Dengue, Yellow Fever.

4.—The Zymotic or Enthetic diseases:—

Influenza,	Tropical Dysentery,
Cerebrospinal Fever,	Typhoid Fever,
Erysipelas,	Cholera,
Puerperal Fever,	Plague.

It will be seen that a considerable proportion of the diseases mentioned have not yet been proved by ocular evidence to be due to any definite micro-organism; in fact, no such organism has yet been accepted as the cause of our most common children's ailments: measles, whooping cough, and even scarlet fever; but although no parasite may have been described and cultivated, who can doubt but that all the diseases of this class, having the characteristics of contagion, will some day be found to depend upon a contagium vivum?

The influences of bacteria in the production of disease has, then, been immense; they have been at war with all living things, and from the beginning of time they have been the most potent factor by which the struggle for life has kept down an excess. We see their influence unchecked in the epidemics of the middle ages, and cannot but wonder what new method will ultimately prevail to prevent over-population when human knowledge and ingenuity have enabled us to cope successfully with the destructive agencies of pathogenic germs.

The specimens I have for your inspection are sections of the lung of a chimpanzee, one of the last of a series of deaths from what has appeared, clinically, to be an epidemic disease. The immediate cause of death was gangrenous pneumonia, but on *post-mortem* examination it was found that the lungs contained an abundance of miliary tubercle, and that almost every organ in the body showed evidences of tuberculosis; the mesenteric glands were much enlarged, and many of them had undergone suppuration; the spleen had numerous masses of caseous matter, some of which had broken down, forming small abscesses. On microscopic examination we found that the softened matter of the mesenteric glands, that from the spleen, and that from the lung, all contained abundant and large tubercle bacilli; sections of the lung were found to be crowded with them, and it is scarcely possible to look at well-stained sections of tuberculous tissues, such as these, without being at once convinced of the important part which the bacillus tuberculosis plays in the pathological process of both local and general tuberculosis. The case of this young, four-year-old chimpanzee was clearly one of general tuberculosis, which appeared to have commenced from the alimentary canal, and to have affected the mesenteric glands, much as they are in *tabes mesenterica* of the human infant.

This case has suggested certain reflections, bearing on the subjects of tuberculosis and of contagious diseases in general, which I shall now proceed to indicate.

We assume that the bacillus, now so easily seen, since the method of staining it was discovered by Koch, is the virus, the particulate poison, the existence of which had been proved by Villemin, long anterior to the time when the stained bacillus was first seen. Whether the poison which gives rise to constitutional symptoms is a chemical or physiological one; whether it be the living germ or the ptomaines produced by them, is immaterial, as in either case the poison is conveyed by particles, and is introduced into the living tissues in the particulate form, whether germs or not. As regards the method of conveyance of the virus, and the various channels by which it may be introduced, much has recently been made out. We know that the air around us is constantly contaminated with living particles; the floating matter of the air is at all times capable of inoculating sterilised test-tubes; such air is introduced within the respiratory tubes, and the alimentary canal in the processes of respiration and digestion. But it has been pointed out by Dr. Lauder Brunton that the contents of the alimentary canal are not part of the body; a tube may pass through a box, but the contents of the tube are not in the box; a barrier of epithelium lines all parts of the alimentary tract, and the addition of a few more species of bacteria to those always present in the digestive canal will, under conditions of health, make little difference.

Many of these, as is well known, will be rendered innocuous by the process of digestion, as was illustrated by Dr. Klein when he ventured to partake of a cholera-bacillus dinner; others which escape digestion will be hurried rapidly along with the stream and not find any satisfactory nidus for germination.

Again, in the case of the respiratory tract, the germ-laden air will doubtless deposit some of its particulate burden on the moistened mucous membrane, where the particles will be retained. That this is the case was shown by the experiments of Tyndal, who found that the residual air from the lungs was absolutely free from particles which would reflect the electric beam, and this fact is confirmed by the observations of Lister and others that, in cases of Empyema with Pneumothorax, the air escaping from a small opening in the periphery of the lung does not necessarily convey any septic germs into the pleura. The particulate germs will then rest on the surface of the mucous membrane of the larger respiratory tubes. They will not penetrate the deeper parts of the lung, the alveoli, where the epithelium is deficient or absent, but will be propelled by ciliary action towards the outlet, and either discharged by expectoration or find their way into the alimentary canal.

The protecting barrier of epithelium exists, then, along both respiratory and digestive tubes, and will effectually prevent the introduction of the germs to the lymph and blood channels if the mucous membrane be healthy. We may look upon this line of defence as by far the most important, both by its protective influence, and by its destructive action on the germs through the solvent action of the digestive juices.

But now, supposing that the living bacilli, or their spores, have passed this first barrier, they may then reach either lymph or blood channels, and may, of course, give rise to general blood-contamination, or may even then be destroyed by the defensive action of the lymphatic glands or leucocytes. Here we have a second and a third barrier, which may effect the destruction of the germs before they have had time to germinate, and recent observations show that the agency of lymphatic glands as vital filters has not been fully realized.

In the case of the chimpanzee, the disease introduced by the food—possibly by means of milk—had affected an immense number of the mesenteric glands. These had retained the bacilli, which were present in the liquid pus resulting from the breaking-down of the diseased glands. The pus and the contained bacilli might then be discharged from the body if an outlet could be found, or it might gradually dry up, leaving a harmless calcareous mass.

Dr. Sims Woodhead has recently directed attention to the agency of the lymph-glands in arresting tuberculosis. He points out the fact that commonly tuberculosis of glands is the primary lesion, and that the glands in the root of the lungs may become tuberculous in mesenteric cases, the tubercle in the lung itself being of more recent growth. The connection between milk-feeding and tuberculosis is clearly established, as showing that the virus reaches the mesenteric glands by the alimentary canal. It has been found that, although tubercular disease of the mamma is in the human subject rare, yet it is common in cattle, and that bacilli are always found in the milk in these cases. Recently, it has also been found that tuberculous cows give contaminated milk, even although the mammary glands may not be diseased. The connection of infantile tuberculosis with milk is shown by the following table of cases of mesenteric disease :—

First year, child at mother's breast	...	4 cases.
1 to 2½, cow milk chiefly	... ...	33 ,,
3 to 5½	... ...	29 ,,
6 to 7½	... ...	12 ,,
8 to 10	... ...	13 ,,
11 to 15	... ...	9 ,,

The glands in these cases are found to be in various stages of enlargement, liquefaction, softening, suppuration, or calcification. The bacilli are commonly present, but when calcification has occurred they may be few or absent, and the nature of the disease can then be proved by inoculation only.

Lymphatic glands are accordingly believed to act as vital filters. They are very active in early life and swell on the least stimulus. If the stimulus be too great, their nutrition fails, the tissue elements are destroyed, they degenerate, liquefy, suppurate, and so throw off the virus. If they calcify, the virus or its product remains in a harmless condition, although not thrown off from the body by suppuration and abscess.

It would appear, then, the opposing influences at work to prevent the introduction of bacteria are much more effective than have been commonly supposed; and it is to these influences that we owe our preservation from daily destruction. It has been shown by Mr. Wallace, in his book on Darwinism (page 25), that one fly would in three months of summer produce one hundred millions of millions of millions—a number greater than exists at any one time in the whole world, and that "to prevent this tremendous increase there must be incessant war against these insects, by insectivorous birds and reptiles as well as by other insects, in the larval as well as in the perfect state, by the action of the elements in the form of rain, hail, or drought, and by other unknown causes. Yet we see nothing of this ever-present war, though by its means alone, perhaps, we are saved from famine and pestilence."

How much more active is the contest between Bacteria and all living things! Countless numbers are being produced in a very short time; but few of these survive the opposing influences, in spite of the property of immortality recently given to them by Weisman.

As regards the defensive action of the leucocytes, I need only give a quotation from Bland Sutton (p. 127):—

"If we summarise the story of inflammation, it should be likened to a battle. The leucocytes are the defending army, their roads and lines of communication the blood-vessels. Every composite organism maintains a certain proportion of leucocytes as representing its standing army. When the body is invaded by bacilli, bacteria, micrococci, chemical, or other irritants, information of the aggression is telegraphed by means of the *vaso motor* nerves, and leucocytes rush to the attack. Reinforcements and recruits are quickly formed to increase the standing army—sometimes twenty, thirty, or forty times the normal standard. In the conflict cells die, and often are eaten by their companions. Frequently the slaughter is so great that the tissue becomes burdened by the dead bodies of the soldiers in the form of pus, the activity of the cell being testified by the fact that its protoplasm often contains bacilli, etc., in various stages of destruction. Those dead cells, like the corpses of soldiers who fall in battle, later become hurtful to the organism they in their lifetime were anxious to protect from harm, for they are fertile sources of septicæmia and pyæmia."

The most effectual method of introduction of a bacterial poison is by inoculation. This in the lower animals is a certain method, and there have been a few instances recorded of the accidental inoculation of the tubercle bacillus into the human subject; the skin, when intact, is a very effectual barrier, and even when ulcerated is rarely the source of blood contamination.

We are now able to realise how it is that there are varying degrees of contagion, and how it has come to pass that such a disease as tuberculosis is not yet classed amongst contagious diseases. We have seen that the spores have a difficulty in finding their way through the opposing barriers, and so inoculating the circulating fluid. These difficulties will vary with the individual germ, and account for the varying degrees and limitations of the contagious quality amongst the different members of the group of diseases classed as contagious.

It is difficult to define accurately or to limit the powers of resistance of the body to contagion. As is well known, no hard and fast lines can be drawn in this respect, as the vagaries of contagious diseases are numerous, and they are not altogether amenable to discipline and rules. With some, robust health forms no barrier, as the most robust individuals often give way the most quickly. In other diseases the maintenance of the resistent energy of the body is the most effectual mode of preventive treatment. On the other hand, it is remarkable that such a disease as scarlet fever should be so amenable to the action of antiseptics and disinfectants as it is almost always found to be, inasmuch as one case in a house rarely gives rise to others if proper antiseptic precautions with isolation are carried out with reasonable care.

As regards the utility of antiseptics and disinfectants, it goes without saying that their great use is on the contagium vivum outside the body. The destruction of the virus is the main object of disinfection, and we have no better illustration of this than in the case of scarlet fever just mentioned, where the poison is given off by the skin, and can easily be destroyed by inunction with any efficient germicide. The destruction of the virus should also be attempted in the case of tuberculosis. It has been abundantly proved that the sputum is the means by which the virus may be most easily disseminated. This can be readily destroyed, and the doing so will be a far more efficient course than the cruel and unreasonable one of isolation of the patient—a course which is perfectly unnecessary and useless.

The further question as to the utility of medicinal disinfectants in modifying the germination and development of the virus after its introduction within the body, is a large question still *sub judice*; it is often stated that no germicide can safely be introduced within the body in sufficent quantity to disinfect the whole mass of blood and tissues, but, when we consider what slight influences will affect the germination and growth of bacteria in the test-tube, it is not a Utopian quest to search for a method by which their active increase may be put a stop to after they have been introduced, and by which the resistent energy of the body may be allowed to become the superior force, and the virus be ultimately destroyed.

We are learning, gradually, more and more of the life-history of the various contagia commonly existing around us; we are also becoming more and more familiar with the actions of the large class of disinfectants by which they may be either destroyed or arrested in their growth. When our knowledge of both contagia and germicides is more complete we may hope that, not only will preventive medicine have achieved greater triumphs than at present, but curative measures will be found, by which the active contagious diseases may be arrested in their progress.

The means at our disposal, by which the contagious diseases, as a class, may be avoided or controlled, may be grouped under five heads:—

1.—Keeping out of their way. Absence of body is in this case better than presence of mind. But do not let us fall into the common error of having an undue fear of contagion. People suppose that medical men have some magical power of warding off contagia from themselves and their families; they have no such talisman: they go where duty calls them, and take the risk.

2.—Maintenance of the resistent energy of those who may be exposed to contagion. We all know how important this is in a disease like Phthisis, where the restoration of good digestion and improvement in nutrition are far more important than measures directed towards the destruction of the virus.

3.—Destruction of the virus as it is discharged from the body. Disinfection of the sputum, skin, fæces, etc.

4.—Destruction of the virus within the body by internal disinfectants—local or general.

5.—The avoidance of all food or drink which may have been contaminated, or is uncooked.

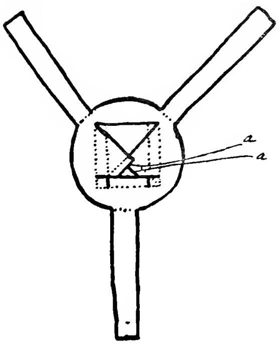
In the Cell produced directly by the zoospores of *Synchytrium Taraxici* the nucleus has been found of 14μ and the nucleolus 8μ. Shortly after this size has been attained division commences, resulting in the production of from 150 to 300 nuclei in the one cell. So says M. Dangeard, *Comptes Rendus*, cix., 1889, p. 202.

A Camera Lucida for Nothing.

By J. W. Plaxton.

THE other day, after a morning's work, something went wrong with the prism of my camera lucida, and, do what I would, I could not bring it back to usefulness. At a loss for the moment, I cast about for a substitute, and in half-an-hour, with penknife and pencil, out of a piece of stiff paper and a square of thin glass, had turned out a fragile but efficient substitute for what is known in catalogues as "Beale's Neutral-tint Glass Reflector," price 6s.

This is how I did it :—Describe a circle by standing the eye-piece of the microscope on the paper and running a pencil round it; inscribe a square in the circle already drawn by drawing the pencil along the edges of the square of thin glass you intend to use; now lay down the diagonals of the square; draw three other lines within the square, each one parallel with a side of the square, and each, say, one-eighth of an inch from the side; draw two other short lines (*a.a.* in the diagram) parallel to the diagonals.



Take the penknife, and, following the continuous lines of the diagram, cut through the paper. You will have, in paper, what resembles a three-spoked wheel without tire. The upper triangle of the four within the square falls away as useless; the lateral triangles open outwards, and stand at right angles with the plane of the circle; the little flanges on their lower edges are made by creasing the paper to support the thin glass. The base of the lower triangle answers the same purpose.

Put the eyepiece in the microscope, the circle of paper to the end of it: turn the spokes of the wheel back along the tube, and slip a tiny elastic band over them, or tie them with a thread; a little manipulation with the fingers, the thin glass is in place, and the thing is done.

Need I say that anyone can see that it would be almost as easy to use a piece of thin sheet brass or other metal as to use paper? I enclose the original instrument and a diagram.

Autumn in the New Forest.

By G. C. Turner.

"THE harvest is past, the summer is ended"; the flowers which but a few short weeks since studded the fields with gold have departed now. The water-courses have lost their August glory, but there are still a few stragglers left by the waysides; a few flowers seem loath to leave us and are lingering yet.

Will a walk across the New Forest mean a blank day—botanically speaking? We will see. A walk of two-and-twenty miles will do us no harm anyhow. As we have to catch a train at the end of our ramble, we shall not have very much time for serious search; but even if we had time, people "who know" say, "Never leave the New Forest paths unless you have a compass with you. They are more easily lost than found again."

Brockenhurst is our starting point, and we make straight for Lyndhurst, the capital of the Forest. It is a lovely day in the early autumn: the sun is blazing down upon us in July splendour, intensifying the beauty of the woodland scenery, lighting up the forest shades with broad flashes of sunlight, and throwing the masses of foliage into beautiful relief.

The ditches are bright with the flowers of the Lesser Spearwort, growing in company with the Water Speedwell (*V. anagallis*), Water Mint, and Marjoram, whilst the Vervain grows freely by the dry roadsides. The St. John's Worts are represented by *Hypericum pulchrum*, *H. quadrangulum*, and *H. Androsæmum;* but the plant which strikes us most is the tall Wood Spurge (*Euphorbia amygdaloides*), with its leafy stem throwing out the slender branches, which are crowned by pale-green, connate bracts. The parasites are represented by the red Bartsia and the common Eyebright (but not the little Eyebright we are familiar with), some two or three inches high. The plants here are fully ten or twelve inches in height and are much branched. Further on we find the great Dodder, turning its scarlet, thread-like stems with the grasp of an octopus round its reluctant host, the Common Gorse.

A short pause at Lyndhurst: five minutes in the pretty church to admire Sir Frederick Leighton's beautiful fresco, and we are on our way again.

What have we here? On a bed of wet moss, a colony of Sundew plants—both *Drosera rotundiflora* and *intermedia*, some half-dozen of which have flowers fully expanded. This is a sight we have never seen before, though we have noticed many hundreds of plants during the past week. The buds have been shining white—that was all, and though we have been keeping plants in one room and feeding them carefully, they never repaid us by unfolding their petals. We note the time--it is five minutes past one—and pass on.

Yellow is certainly the prevailing colour. Besides the St. John's Worts and Hawkweeds, there are the bright yellow flowers of the Golden Rod, the Henbane, and Agrimony. As a relict, we are pleased to see the bright-blue Chicory, the Marsh Housewort, the Lesser Skullcap, the Common Centaury, and the strangely incomplete-looking flowers of the Bur Mangold. The commons are purple over with Heath and Heather. The Dwarf Gorse, ablaze with flower, is seen only here and there; the Common Gorse prevails, and its flowering time is past. We are nearing the borders of the forest, but the flowers are brighter still.

The Great Mullein proudly rears its head and makes a goodly show, and, fairer still, the Black Mullein, with its beautiful purple filaments, is growing fully as tall as its hoary cousin. Worthy of a place in any garden is the beautiful double variety of the Common Soapwort, which grows here freely enough; and we must not overlook the tiny, though interesting, Thyme-leaved Flaxseed.

Further on yet is the Small Bugloss, the Viper's Bugloss, and the Lesser Snapdragon; whilst on the cliffs which guard the seashore the Common Borage grows, to all appearance no alien, but a real native.

It is evening. The glow in the west tells of another day departed; the twinkling stars are heralding the night. If we have not found the pride of New Forest—the Gladiolus—we seem to have the comfortable assurance that the day has not been misspent.

Aspect of the Heavens:
January, February, and March, 1890.

By A. Graham, M.A., etc., Cambridge Observatory.

THE *Sun* will be at its least distance from the earth (90,831,000 miles) on January 2, at seven in the afternoon; and at mean distance (92,385,000 miles), on April 1, at seven in the afternoon. These numbers, though not far from the truth, can only be looked upon as provisional, until all the reliable observations available for determining the sun's parallax shall be carefully discussed. Of this fact we are certain, that we are more than a million and a-half miles farther from the sun on April 1 than on January 1. The meridian altitude of the sun will be 27 degrees 38 minutes greater on April 1 than on January 1; and this corresponds to an increase in the length of the day, in the latitude of Greenwich, from 7*h.* 56*m.* on January 1 to 12*h.* 58*m.* on April 1, reckoning from sunrise to sunset. The sun will cross the equator northward on March 20 at 4 aft., and the spring quarter commences.

The equation of time goes on increasing, from 3*m.* 54*s.* on January 1 until February 11, when the clock ought to be 14*m.* 28*s.* in advance of a good sun-dial; it afterwards decreases until April 1, when the clock is again 3*m.* 54*s.* fast.

Phases of the Moon.

Full Moon—Jan. 6th, 5*h.* 37*m.* morn; Feb. 5th, 1*h.* 13*m.* morn; March 6th, 6*h.* 48*m.* aft.

Last Quarter—Jan. 14th, 6*h.* 33*m.* morn; Feb. 12th, 6*h.* 51*m.* aft.; March 14th, 4*h.* 5*m.* morn.

New Moon—Jan. 20th, 11*h.* 49*m.* aft.; Feb. 19th, 10*h.* 28*m.* morn; March 20th, 9*h.* 1*m.* aft.

First Quarter—Jan. 27th, 8*h.* 16*m.* aft.; Feb. 26th, 2*h.* 6*m.* aft.; March 28th, 9*h.* 33*m.* morn.

Moon in Apogee—Jan. 6th, noon; Feb. 2nd, 2*h.* aft.; March 2nd, 3*h.* morn; March 29th, 10*h.* aft.

Moon in Perigee—Jan. 20th, 3*h.* aft.; Feb. 18th, 2*h.* morn; March 18th, 3*h.* morn.

The Moon ascends in her orbit till Jan. 5, at 10*h.* aft., when her North declination is 23 deg. 43 min. 47 sec.; then descends until her South declination is 23 deg. 44 min. 25 sec., Jan. 19, at 6*h.* aft.; again ascends till Feb. 2, at 4*h.* morn, declination 23 deg. 45 min. 37 sec. North; then descends till her South declination is 23 deg. 50 min. 14 sec. on Feb. 16, at 4*h.* morn; another maximum North declination, 23 deg. 55 min. 16 sec., on March 1, at 10*h.* morn; maximum South declination, 24 deg. 3 min. 26 sec., March 15, at 10*h.* morn; and maximum North declination, 24 deg. 10 min. 44 sec., on March 28, at 5*h.* aft.

She will occult the planet *Neptune* on Jan. 2, Jan. 29, Feb. 26, and March 25; and the planet *Mars* on March 12; but none of these phenomena will be visible in our islands.

She will be in conjunction with *Mercury* on Jan. 21, Feb. 17, and March 19; with *Venus* on Jan. 20, Feb. 19, and March 21; with *Mars* on Jan. 15, Feb. 12, and March 12; with *Jupiter* on Jan. 20, Feb. 17, and March 16; and with *Saturn* on Jan. 10, Feb. 6, and March 5.

On Jan. 19, at 9 in the morning, the angular distance of *Venus* and *Jupiter* will be less than half a degree; and on March 5, at 4 in the morning, *Mars* will be within eight minutes of a small star in Scorpio, marked *Beta*.

Mercury will be at its greatest elongation eastward from the Sun, and for several evenings may be seen low in the south-west about an hour after sunset. Its greatest elongation westward occurs on the night of Feb. 23; but it rises too near the Sun to be visible with the naked eye. On the 29th, at 6 in the afternoon, this planet will be in inferior conjunction with the Sun.

Venus will be in superior conjunction with the Sun on the 18th an hour before noon, and will not be visible these three months without the aid of a telescope.

Mars is properly the morning star. It rises on Jan. 1 at 2*h.* in the morning, on Feb. 1 at 1*h.* 30*m.*, on March 1 at 0*h.* 54*m.*, and on April 1 at 11 minutes before midnight.

Jupiter will be in conjunction with the Sun on Jan. 10 at 5*h.* in the morning. About the middle of March it will begin to be visible as a morning star.

Saturn crosses the meridian on Jan. 11 at 3*h.* in the morning, Jan. 26 at 2*h.*, Feb. 9 at 1*h.*, Feb. 22 at midnight, March 8 at 11, and March 23 at 10 in the evening; and is consequently above the horizon the greater part of the night. The extreme length of the ring is now about two and a-half times the diameter of the globe, and the diameter of the globe about twice the breadth of the ring.

Uranus crosses the meridian on the morning of Jan. 15 at 6*h.*, Jan. 31 at 5*h.*, Feb. 15 at 4*h.*, March 2 at 3*h.*, March 17 at 2*h.*, and on March 31 at 1*h.*, at an altitude of 29 degrees.

Neptune will be due South on the afternoon of Jan. 5 at 9*h.*, Jan. 20 at 8*h.*, Feb. 4 at 7*h.*, Feb. 19 at 6*h.*, March 7 at 5*h.*, and March 22 at 4*h.*, at an altitude over 57 degrees.

On Feb. 13, the apparent motion of this planet among the fixed stars changes from retrograde to direct, or from westward to eastward.

A New Form of Clip for Balsam Mounting.

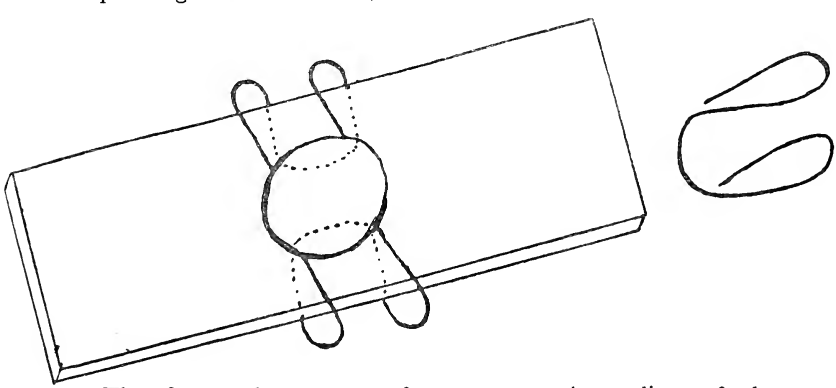
By G. H. Bryan, B.A., F.C.P.S.

THERE are few practical microscopists who do not admit that the spring clips which have for so many years been used in mounting objects in balsam are a failure. It is only necessary to turn over the back numbers of the *Journal of the Royal Microscopical Society*, *Journal of Microscopy*, *Scientific Enquirer*, or *Science Gossip* to find the same complaints made again and again as to their defects. The usual query which has been repeatedly asked is, "Why does air run in as soon as the clip is removed?" The answer is pretty obvious, viz., that the object yields to the pressure of the clip as long as it is subject to it, but as soon as that is taken off, the elasticity of the specimen causes the latter to lift the cover up again, and what naturally happens? Why, of course the air runs in, because "nature abhors a vacuum."

Nor is this the only fault of spring clips, for even a moderate amount of pressure is sufficient to damage many delicate specimens. Take the case of sections of stems of plants: the effect of squashing very frequently makes the cells and vessels in parts turn on one side, and where each cell should by rights be in its natural place, nothing is seen but a jumbled mass of tissue.

Yet spring clips are still frequently used in balsam mounting, the reason being that they fulfil a twofold purpose. One use of them is to produce pressure. This, as we have seen, is a bad purpose. Not but what a certain small class of specimens require flattening out, but this must be done before mounting them; it is too late to make the attempt when they are in the balsam. Their other use is to keep the cover in place while the balsam is hardening, and it is for this alone that they are usually used. They do not accomplish this end practically, for as a general rule, in applying the clip, the cover gets slightly shifted to begin with; moreover, they are almost certain to tilt the cover on one side or the other unless supports have been placed round its edges.

Nearly two years ago the idea occurred to me that what was wanted was an arrangement that would hold the cover in its proper position by firmly gripping the edges instead of pressing down on the top of the glass. Since then I have mounted a number of slides, using these "pressureless edge clips" until the balsam has hardened, and with such success that now I "use no other." Whilst several friends to whom I have shown the "dodge" have decided to make similar clips for their own use at once, one microscopist regretted that he had not known of the contrivance earlier, as he had already spoilt many slides by "squashing" them.



The figure shows one of my pressureless clips of the natural size, and how they are used for keeping the cover of a slide in its proper position. It will be noticed that two clips are necessary, and when in use they firmly clip the *slide only*, their four points resting *against the edges*, *not on the top* of the covering glass. In this way the cover is perfectly firmly held in position; it is impossible for it to slip out of place, while no pressure is applied to the object. In applying them to the slide they are first clipped on anywhere, and then pushed up until their points touch the edges of the thin glass circle; this can *generally* be accomplished without shifting the latter perceptibly. The slide can then be handled with perfect impunity, no matter how soft the balsam may be, and a good deal of the superfluous balsam may be removed if care be taken not to displace the clips. The balsam may then, if advisable, be hardened under more or less heat, and I find the top of a hot-water cistern is a first-rate drying ground for the purpose. After about a fortnight in such a position, even slides mounted in *ordinary* balsam will generally be found sufficiently hard to be cleaned with perfect safety, but theoretically it is evident that the time taken to harden under the cover is the same as the time taken to harden in an open vessel by a layer of balsam whose thickness is one quarter the diameter of the covering glass. When the balsam is fully set the points of the clips will be firmly stuck down on the slides, but there is no difficulty in pulling them off; if necessary, the wires *might* be heated, but this is not required.

I now make the clips of brass wire, the length required for each being about $2\frac{1}{2}$ inches. It is advisable to make the clips of different sizes to accommodate the different sizes of cover-glasses, and, properly, the distance between the points of the clip should be about seven-tenths of the diameter of the covers for which it is made. For use with some mounts it is convenient to bend the points of the clip inwards, while if the object be a very thick one the points turned down will be found very useful. Where neither of these things is done, I file off the ends at a suitable angle so that they hold the edges of the cover more firmly; but different microscopists will probably introduce different modifications in the form of the clips to suit their own fancy.

With this paper I am sending a pair of the clips, so that the Editor may be able to try them on a glass slip with the cover merely laid on. My only wonder is that this simple and, withal, effectual contrivance was not thought of long ago.

Presidential Address to the Bath Microscopical Society.

By W. G. Wheatcroft.

ALLOW me, in the first place, to thank you for the honour you have done me in electing me President of this Society. I felt great diffidence in accepting the office, and am conscious that it is to your generosity, and not to any merits of my own, that I owe the distinction you have conferred upon me. I rely, with much confidence, on your continued kindness, both in bearing with my shortcomings and in cordially assisting me to carry out the work of the session in a satisfactory manner. It requires no ordinary amount of courage to address a body of microscopists when the majority of them have had more experience in the study and practice of microscopy than the speaker. This knowledge ought to teach me one lesson ; namely, the cultivation of modesty. A great living microscopist, Professor Virchow, once observed "that life is just long enough to teach us our ignorance." I must confess that each year of my life brings with it a discovery, which is, how little I know and how much I have to learn, even upon the subjects I know something about. Until I joined this Society I had scarcely given any attention whatever to Cryptogamic Botany, and but for my good fortune in becoming a member thereof I should probably have remained completely ignorant of that branch of botanical science. I am convinced that if a botanist once begins to study the life history of the Cryptogamia, he will become so fascinated with it that for the future, if any of his botanical studies are neglected, they will be those which relate to the Phænogamia and not the Cryptogamia. Whilst speaking on this subject I should like to call your attention to a work which has recently been published. It is a "Handbook of Cryptogamic Botany, by A. W. Bennett, M.A., F.L.S., and George Murray, F.L.S." Many of you are doubtless aware that until the appearance of the book referred to no general handbook of Cryptogamic Botany in the English language had been published since the Rev. M. J. Berkeley brought forth his admirable treatise in the year 1857. Our library contains Mr. Berkeley's book, and will, I trust, soon possess that of Messrs. Bennett and Murray. So many discoveries have been made in this department of knowledge since 1857 by men of European fame, that it would be almost invidious to mention names; but as three of these Cryptogamists have gone to their rest, I may just remind you how much we owe to the labours of De Bary, M. J. Berkeley, and C. E. Broome. I had the pleasure of being introduced to the Rev. M. J. Berkeley at Llandudno in 1870. One of the scientific periodicals, in announcing Berkeley's death, in his eighty-seventh ear, speaks of him as "our greatest authority on Cryptogamic Botany." He was a man of great mental capacity, and a hard worker. In the early part of his career he must have had occasion for all the courage he so admirably displayed. He has left a name that will live in the annals of Cryptogamic Botany, and will ever be associated with that of a former member of our Society, the late Mr. C. E. Broome. May we hope that the labours of these eminent mycologists will not only be appreciated, but will act as incentives to exertion in the same direction amongst some of the younger members of this and kindred Societies, who have yet long years to look forward to in which to perfect the studies they may elect to identify themselves with.

One of the great charms of a Society like our own, to my mind, is, that owing to the common interest we take in an instrument, which has become almost indispensable to students of such sciences as Biology, Botany, Zoology, Geology, and Chemistry, as well as being much resorted to by those who pursue kindred studies, men of very different acquirements and modes of thought are frequently brought together, and enabled, by means of papers and otherwise, to communicate to one another the result of their observations and studies in the various branches of knowledge to which they have given special attention. Such a method of acquiring information has a two-fold advantage. It not only relieves us from the weariness of excessive book-reading, but it engenders an appreciation of the work of others, and a kindly interest in their labours. A former President—my friend, Mr. Norman—only a short time ago gave us such an exhaustive account of the progress of microscopical science, and of the recent improvements in lenses and other appliances, that it would be a work of supererogation, if not of presumption, on my part, to attempt to add anything to what has been so well said by a predecessor in this office. In a Society like ours, which has existed for some 30 years, and has been presided over by men of great learning and ability, the task of preparing an address is not a light one; for the President-elect is pretty certain to find that almost every subject of interest, upon which he feels he might have something to say, has been exhaustively treated by a former occupant of this chair. There is one subject which has not only attracted, but I might almost say, has in many cases absorbed the attention of naturalists during the last quarter of this century. I refer to those great problems which are involved in the laws which seem to regulate the development of organic beings. The publication of that admirable work of the great naturalist, Charles Darwin, "On the Origin of Species by Means of Natural Selection," marked the advent of the theory of "evolution," as it has been generally called, in this country. Few theories have been more travestied or roughly handled. Such a description of it as the following by a well-known poet is as good an example of this as any that occurs to me:—

> "That mass man sprang from was a jelly lump,
> Once on a time; he kept an after course
> Through fish and insect, reptile, bird, and beast,
> Till he attained to be an ape at last,
> Or last but one."

Professor Alleyne Nicholson, in his able work entitled "The Ancient Life History of the Earth," observes, "Geology teaches that the physical features which now distinguish the earth's surface have been produced as the ultimate result of an almost endless succession of precedent changes. Palæontology teaches us, though not yet in such assured accents, the same lesson. Our present animals and plants have not been produced, in their innumerable forms, each as we now know it, as the sudden, collective, and simultaneous birth of a renovated world. On the contrary, we have the clearest evidence that some of our existing animals and plants made their appearance upon the earth at a much earlier period than others. In the confederation of animated nature some races can boast of an immemorial antiquity, whilst others are comparative *parvenues*. We have also the clearest evidence that the animals and plants which now inhabit the globe have been preceded, over and over again, by other different assemblages of animals and plants, which have flourished in successive periods of the earth's history, have reached their culmination, and then have given way to a fresh series of living beings. We have, finally, the clearest evidence that these successive groups of animals and plants (faunæ and floræ) are, to a greater or less extent, directly connected with one another. Each group is, to a greater or less extent, the lineal descendant of the group which immediately preceded it in point of time, and is more or less fully concerned with giving origin to the group which immediately follows it. That this law of "evolution" has prevailed to a great extent is quite certain, but it does not meet all the exigencies of the case, and it is probable that its action has been supplemented by some still unknown law of a different character. It is the obvious working of what Professor Nicholson refers to as "some unknown law," which, I take it, conduces to the indestructibility, or permanency, of type, which for a long time made me doubt the truth of the theory of "evolution."

Further inquiry and observation have convinced me that natural selection is a true cause, and that whatever may be the final result of our inquiries—whether animated nature be derived from one or many ancestral sources—still the origin of species by natural selection will, I believe, be found to be a true cause. How far the present condition of living beings is due to that cause, and how far, on the other hand, the law of natural selection has been acted on and controlled by other natural laws, such as permanency of type, atavism, etc., how many types of life originally came into being, and whether they arose simultaneously or successively—these and many other questions seem to me to be still unsolved. The field of labour for the biologist is a vast one, and though that great naturalist, Chas. Darwin, has left us the key to the entrance gate, if I may be allowed the simile, there are still many doors closed to us. It seems to me that nothing is more unfair or uncharitable when discussing what, after all, is a question of the *modus operandi*, than to charge some of those who seek after truth for its own sake with a want of religious or reverential feeling, simply because they happen to see through spectacles different from our own. One of our most eminent biologists—Professor Huxley—having been designated an atheist by a writer in one of the leading periodicals of the day, replied in the following manly fashion :—" I do not know that I care much about popular odium, so that there is no great merit in saying that if I saw fit to deny the existence of a God I should certainly do so for the sake of my own intellectual freedom, and be the 'honest atheist' you are pleased to say I am. As it happens, however, I cannot take this position with honesty, inasmuch as it has always been a favourite tenet of mine that Atheism is as absurd, logically speaking, as Polytheism."

I think I may venture to say that microscopists in their examination of the "infinitely little" find abundant evidence both of design, and unity of design, in their researches. I feel I ought to apologise for having spoken so freely on a much-controverted subject; but I do not like to sail under false colours, and a paper I read in this room a short time ago would naturally lead some of my audience to conclude that I was opposed to the theory Darwin propounded in his "Origin of Species."

AT REYKJAVIK a society has just been established, under the presidency of Professor B. Grondal, called the Icelandic Naturalists' Society, the chief aim of which is to found a museum of natural history for Iceland, to be the property of the country. For this purpose it is not only intended to collect specimens of the fauna, flora, and mineral deposits of Iceland, but also to obtain, by exchange, or in any other convenient manner, specimens from abroad.

The Romance of Science.

BY THE REV. HILDERIC FRIEND, F.L.S.

NEVER were greater efforts made than at the present time to create and sustain an intelligent interest in Nature, and at no former period of our history have Christian people been so fully alive to the great advantages of such an interest. It is well that we should remember how certain it is that if the Churches, and Christian organizations do not supply the public with reliable information on scientific matters, the work will be done by men whose influence will very probably tend to injure the faith and morals of our youth, rather than stimulate and elevate them. Such being the case, it is right that a magazine conducted on avowedly Christian principles, should give prominence to works published under the auspices of such Committees as represent the *Religious Tract Society* and the *Society for Promoting Christian Knowledge.* It has been a source of gratification to many of our friends, that the latter Society has recently done so much for popular science by the publication of standard works of a non-technical character. The title at the head of this paper has been chosen because of its happy employment by the S.P.C.K. in connexion with a series of books which the Committee is now issuing. The first three volumes of the series are before me as I write, and as I have read every word in each book, it is possible for me to speak of them as one who knows their real merits.

The titles are as follows :—

The Story of a Tinder-box. By Charles M. Tidy, M.B., F.C.S. Price 2s. Containing 40 illustrations and 105 pages of letterpress.

Time and Tide (A Romance of the Moon). By Sir Robert Ball, F.R.S. Price 2s. 6d. Six illustrations, index, and 188 pages.

Diseases of Plants. By Prof. Marshall Ward, F.R.S. Price 2s. 6d. Fifty-three illustrations, index, and 193 pages of matter.

The two former works consist of lectures delivered by their authors, and are intensely interesting. The tinder-box story carries us back to the time of our great-grandfathers, when electric light, lamp, safety-match, and gas were alike unknown, and shows us how they struck a light in the good old times, as well as how the various methods have one by one been superseded as years went by. In Sir Robert's book, however, we go much farther back, and examine both the earth and the moon, as well as other of the planets for an explanation of the mystery associated with the tides. The story is romantic in the extreme.

If Prof. Marshall Ward's work is not at present so popular as the others, the fault is due to the reader or the subject, which does not easily fascinate the public, but is every year being better understood and more carefully studied. The author is exceedingly lucid, and the forms of disease with which he deals are just those about which everyone should try and know something—blights and mildews among flowers, corn, fruit, and vegetables—affecting our food supply, and touching our purse. I know of no works on popular science more worthy of a hearty commendation, or better suited for presenting to young people, than these.

It is not to be supposed, however, that the publications of the S.P.C.K. for the present season in this department are limited to the trio to which I have been referring. A new book by Dr. M. C. Cooke, entitled *Toilers in the Sea* (price 5s.), containing 70 illustrations, 4 plates and index, and 370 pages of matter, also comes from this publishing-house; and in it we have a lucid *résumé* of our present information respecting the Sponges, Zoophytes, Corals, Foraminifera, and other workers in the mighty deep. As many of the creatures whose life-history is here recorded, could formerly be studied only with great difficulty owing to the want of accessible literature, this handbook will prove a most valuable introduction to the several sections of marine life of which it treats. Unfortunately, the rapid production of books is attended in too many instances with one great evil: our young people do not find in them such models of literary and grammatical accuracy as we could wish. It is deplorable to see how many modern writers put singular verb with plural noun (and *vice-versa*), mistake the expansion of the subject for the subject itself, and drop or misuse their relatives and other parts of speech. Dr. Cooke's book (like that of Prof. Lobley, to be mentioned presently) is not altogether clear on this score, as sundry marks in my copy (pp. 129, 136, 180, etc.) show. On page 186 the word *genera* should be put for 'species' at the end of the first paragraph.

Wayside Sketches is the title of Mr. F. E. Hulme's latest book. It is from the S.P.C.K. also, and contains about 70 beautiful illustrations, an index, and 332 pages of letterpress, dealing with all sorts of everyday matters in natural history. It is another of those chatty volumes with which we have of late become familiar from the pens of Mr. Knight, Worsley-Benison, Dr. Taylor, and others; and as Mr. Hulme is not only able to use his pencil in the portrayal of objects, but his pen in producing corresponding word-pictures, his book is full of interest. It is to the same pen that we owe *Familiar Wild Flowers*, published month by month in sixpenny parts, by Messrs. Cassell & Co., London.

Not less romantic, although belonging to a very different class of books, is that entitled *Mount Vesuvius*, which Messrs. Roper & Drowley, 11 Ludgate Hill, London, have recently published at 12s. 6d. This is from the pen of Prof. Lobley, who twenty years ago wrote a treatise on the same subject, and during the long interval has been keeping himself well abreast of his theme. The work is handsomely printed and illustrated, and, what is more, brings our information down to the present time, including the most recent reports from the scene of action up till the time of publication. After describing the region and surroundings the writer depicts the mountain itself, and in three successive chapters details its history from the earliest times. The geology, mineralogy, and botany of Vesuvius each receives its due share of attention, as do also the products of volcanoes generally, and in chapter VIII. the author treats of the fascinating, but difficult problem of volcanic action, and the various hypotheses which have at different times been in vogue to account for the same. To all students of the intricate subject of vulcanology this volume will be most welcome, while the everyday geologist, naturalist, and historian will find its pages teeming with interesting facts and observations. A work of such value will not materially suffer through oversights in revising the proofs, but it is a pity when literary blemishes are allowed in the smallest degree to detract from the finished beauty of such a book; yet several are to be met with in this volume. As I am unable to give a more detailed critique, I may be permitted to assure the reader that *Mount Vesuvius* is worthy of a prominent place in his library.

Half-an-Hour at the Microscope, With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

Plates III.—IV.—V.

The Fungus on Sow-Thistle (Pl. III., Figs. 1–5) is *Coleosporium Sonchi-arvensis.* It occurs not unfrequently on both the common sow-thistle, "*Sonchus oleraceus*," and the field sow-thistle, "*S. arvensis.*" When on the latter it often covers large patches of the under surface of the leaves, and in its prime is of a gloriously rich colour, but this fades to a very dull hue when dried. I found it very plentifully near Portsmouth in the summer of 1874, and have also met with it near Hunstanton, and in this neighbourhood—Fareham.

The genus *Coleosporium* includes six species, found respectively on the Coltsfoot, Butterbur, Harebell, Sow-thistle, Cow-wheat (and its allies Eye-bright and Bartsia), and Rose. With all of these I am familiar, except the last, which, though said to be common, I do not know. To examine them it is necessary to make thin transverse sections of the pustules with the leaves on which they occur. The spores are said to be of two sorts, rounded, produced in spore cases (asci) in the earlier part of the year, and afterwards set free as a granular powder—the "Uredo-form," and at a later season, "obovate cellules placed side by side, each divided transversely by 3 or 4 septa." (M. C. Cooke, Micro. Fungi, p. 120.) Appended is a figure of the fungus in its present state. The slide furnishes a well characterised example of the genus.

White Excrescences on Leaf (Pl. IV., Figs. 1—6).—It is impossible to name them with certainty without being able to dissect them. It is certainly a fungus, one of the *Gasteromycetes* (so named from the spores being borne internally). Puff-balls furnish familiar examples of Gasteromycetes. It is probably a species of the genus *Trichia*, characterised by a stalked or sessile membranous peridium, which bursts at the summit, whence the densely interwoven free capillitium expands elastically, carrying with it the spores (Micro. Dic., "*Trichia*," p. 699). I subjoin illustrative figures.

Seeds of Stellaria Aquatica (Pl. III., Fig. 6).—Botanical subjects being still in the minority amongst the slides exhibited in our cabinets, I insert one of the seeds of the Water Chickweed or Starwort—"*Stellaria aquatica.*" It furnishes a beautiful object and an instructive study of natural dovetailing, as well as inimitable model for armour-plating. It is described along with several other examples of Caryophyllaceous seeds in the *Naturalists' Circular*, for May, 1868, p. 114, and, as space is an object, I must refer those of our members who wish for further information to that source for it.

Spiracle, larva of Stag-beetle (Pl. IV., Figs. 7 and 8.)—This slide furnishes an interesting and beautiful example of Spiracle in a large burrowing Coleopterous larva. The outer crescentic portion is composed of two layers; the network strongly resembles in structure the principal coat of the testa in Rape seed (see Fig. 129, p. 343, in Hassall's "Adulterations detected in Food and Medicine"). I think this just serves as a framework to support a membrane of extreme tenuity, through which the outer air communicates with that in the tracheæ. The coarse, arborescent structure behind (we are looking at the specimen from the outside, so that it would be more correct to say "within") is no doubt for support to the hexagonally reticulate framework.

The central portion is much injured by the action of potash, to destruction by which, and consequent shrinking, the zigzag lines present in this specimen are due. It would be more instructive if the specimens were differently placed on the slide; taking the head of the creature as pointing to the left, the outer curve of the crescent should point to the right. I have (along with some pupæ) had several specimens of this larva brought to me. It is a wonderfully big fleshy fellow, as long and as thick as a man's middle finger, and therefore "very jolly" for dissection. The whole subject of spiracles is one much in need of elucidation; comparatively little has been done at it systematically. The best work, that by the late R. Beck, is locked up and lost to the world, the family declining either to publish or to allow to be published his careful and accurate observations and drawings on the subject. They require to be studied in the living state, and on fresh specimens as well as after preparation.

Egg, Parasite of Ground Hornbill (Pl. V.)—If memory serves me rightly, it approximates most nearly in structure to that of the egg of *Docophorus*, the eggs of one species of which may be readily found above the orbits, or round the ears of young cocks in the coming spring. Perhaps L. H. will kindly send round a specimen; mine are all stowed away, and I don't at this moment know where to put hands upon them. Surely, some of our members, by a little exertion, would be able to procure and send round specimens of the louse itself, properly named, which lays these beautiful eggs, and so add to our knowledge on the subject; it must be readily met with on the bird.

Cheyletus eruditus has by an unfortunate oversight had an incorrect name attached to it. The specimens are really of a species of Thrips, belonging to the natural order, "*Thysanoptera*," sometimes called "*Physopoda*," from the bladder-like suckers terminating the limbs. It is instructive to watch them walking in the "live-box"; to see the little soft, rounded swelling terminating each foot placed on the glass, and by pressure dilated to a beautiful round sucker—there is no trace of claws: the tarsi are two jointed, with indications in the proximal joint of a coalescence of two, if not three elements. To see the parts of the mouth properly, dissection under the simple microscope is required. "The parts of the mouth, although constructed in the mandibulate and palpigirous forms, unite into a short conical sucker, which does not extend beyond the anterior coxa. The clypeus and labium occupy the anterior part, the latter being linear subconical, beneath the base of which arise a pair of horny setiform mandibles, of which the base is dilated into a flattened plate in the spines which I (J. O. W.) have dissected." "The maxillæ are flat, elongate-triangular, and pointed at the tip, without any apparent articulations, and with a two or three pointed palpus, arising on the outer edge near the middle." . . "The labium is submembranaceous, and more or less attenuated in front; in some species the mentum is very distinct, and the labrum is extended in front, between, and of equal length with the palpi," . . . "labial palpi very short, and two or three-jointed." (Westwood, loc. cit., p. 2.)

The 'Thysanoptera' possess points of great interest in their structure, and may be considered as a link between the 'Neuroptera,' as 'White Ants,' 'Dragon-flies,' 'Stone-flies,' which are mandibulate, and the 'Homoptera' (Sage-flies.' 'Canary-flies,' 'Cuckoo-spits,' etc.), which are suctorial.

"The three (apparent) round holes between the eyes" are the cornea of the three Ocelli. "*Cheyletus eruditus*" is a mite, nearly related to the scarlet-jacketted fellows we see in the garden in the early part of summer, "*Trombidium holosericeum*." I'm not sure that I know the Cheyletus, references to figures and descriptions of which will be found under that head in the *Micrographic Dictionary*, by those who will take the pains to look it up.

Thrips.—I omitted in the remarks on Thrips to say that at the tail is seated a 4-valved borer, somewhat after the style of that in the "Blunt-headed Frog-hopper," and to express the hope that some of our members in the ensuing season will dissect specimens and show us the parts of the mouth, the feet, as in life, and the ovipositor.

I know not who placed in the box the remark of Dickens', but I feel sure we ought all to be deeply indebted to him:—"The one serviceable, safe, certain, remunerative, attainable quality in every study and in every pursuit is the quality of attention. My own invention and imagination would never have served me as it has but for the habit of commonplace, humble, patient, daily, toiling, drudging attention."

It is the one thing which makes the difference between man and man, and in microscopical studies it is, beyond all others, indispensable.

Bombylius Medius furnishes a valuable contribution to the best box which has yet come under my notice. The colouring of the wings, as seen with the 4-inch, is exquisite, and it furnishes an excellent specimen for a study of the arrangement of the nervures and cells in a dipterous wing. The modifications of the parts of the mouth are highly interesting. The "labrum" (upper lip) "is spear-shaped; the lingua" (tongue) "as long, but more slender; the maxillæ exceedingly delicate; the palpi composed of a single joint" (*Westwood's Modern Classification*, etc., p. 542). Labium, very long and slender, with but faint indications of the expanded fleshy lobes found in the "House," "Blue," and indeed most other flies. "These insects fly with astonishing rapidity, hovering at times over flowers without settling, and extracting the nectar by means of their long proboscis, making at the same time a considerable humming with their wings" (Ibid). It has been supposed that their larvæ are parasites on the bees they so strikingly resemble. Without having actually traced them out, such facts as I know of their life-history leave no doubt in my own mind that such is the case. I have watched them in sunny mornings hovering over sand-banks, the residence of numerous wild-bees; was fortunate enough to catch one last summer without a net, hovering over the flowers at a spot so thickly bespangled with them that I have named it "Primrose Bank," and caught several wild-bees on flowers in my garden, whose flight, etc. so exactly resembled that of the *Bombylii* that I fully believed, till they were actually in my hand, that they were the latter coveted treasures.

In mounting such slides as this it should be remembered that insects have three pairs of limbs, having a different formation according to different functions, which should all be represented, the left side being chosen by all but universal consent, and the antennæ too should be given.

The Blunt-headed Frog-hopper is a very beautiful and instructive specimen. Is it too much to hope that in time, as these structures come to be more studied *microscopically*, we may be furnished with the true scientific names instead of such as the above?

Some years ago, a large proportion of the insect slides for sale at the London opticians were prepared by an excellent entomologist, the Rev. J. Thornton, of Aston Abbotts. To purchasers and students these were invaluable, from their having the correct names attached ; be it constantly borne in mind that without this, and the help thus afforded to the acquiring a knowledge of the natural objects whence taken, all these beautiful objects really have almost no value.

EXPLANATION OF PLATES III., IV., AND V.

Plate III.

Fungus on Sow-Thistle.

Fig. 1.—Leaf of Common Sow-Thistle, natural size, with spots of its parasitic fungus on the under-surface.

,, 2.—Portion of the same, enlarged 3 diameters.

,, 3.—Section through a fresh leaf containing the fungus, × 100 diameters.

,, 4.—Spores found in December, 1874, × 200 diameters.

,, 5.—Spores of *Coleosporium senecionis*, Groundsel Brand, drawn to same scale.

,, 6.—Seed of *Stellaria aquatica*, as viewed with a moderate power, the elaborate dove-tailing of the cells forming the side, and papillose condition of these round the margin are shown.

Plate IV.

Upper portion illustrates White Excrescences on leaf :—

Fig. 1.—One of the excrescences, × 25 diameters.

,, 2.—Dead leaf of Holly, having fungi on its upper surface very similar to the above.

,, 3.—One of the "white excrescences" of the Holly leaf, enlarged to the same extent as Fig. 1.

,, 4.—Another of these bodies from the Holly leaf, ruptured and showing the pedicle, × 25 diameters.

,, 5.—Portion of the structure highly magnified :—*a*, stellate cells forming the outer covering ; *b*, branching mycelium, with the ends of which the stellate cells are covered ; *c*, spores.

,, 6.—A spore enlarged to twice the extent, × 50 diameters.

Lower portion of the Plate illustrates Spiracle of Larva of Stag-Beetle :—

,, 7.—Represents the spiracle as seen, enlarged 50 diameters.

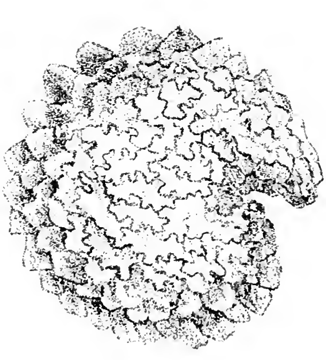
,, 8.—Portion of the sieve-like frame-work, supporting a membrane of extreme tenuity. The coarser arborescent frame-work is indistinctly seen on a lower level—*i.e.*, more internally. × 400 diameters.

Plate V.

Egg of Parasite of Hornbill.

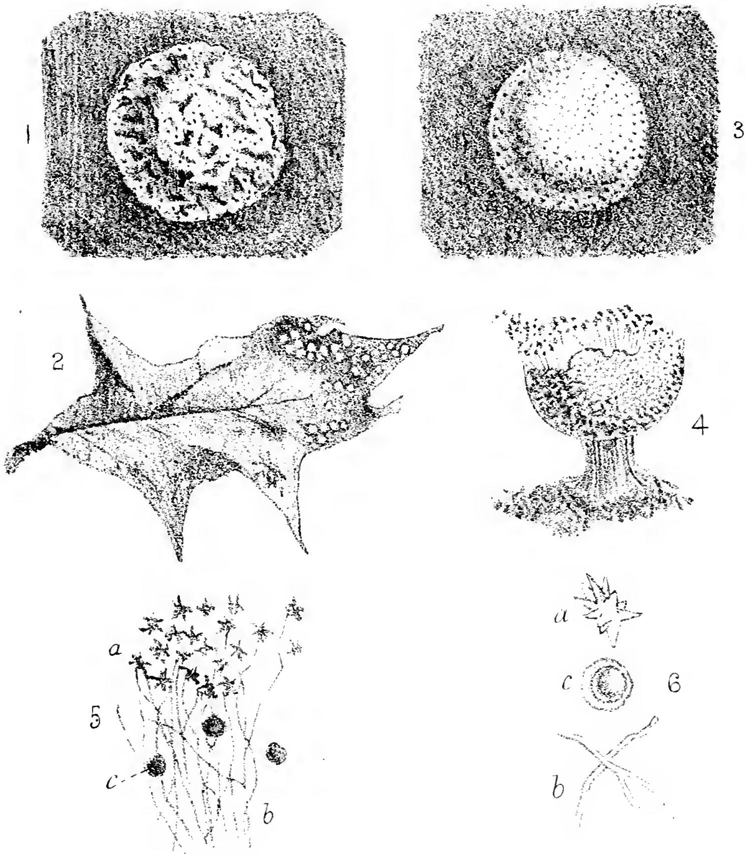
1 2 3 4 5

Fungus on Sowthistle.

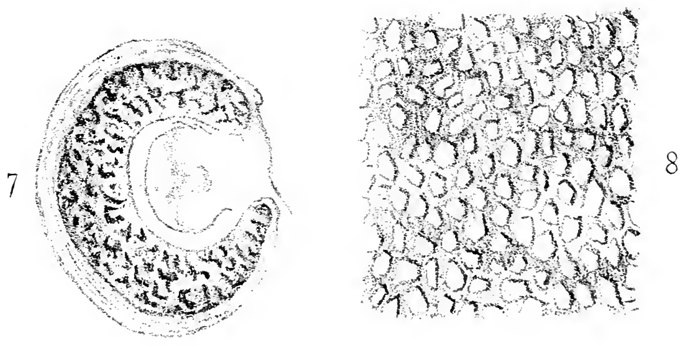


6

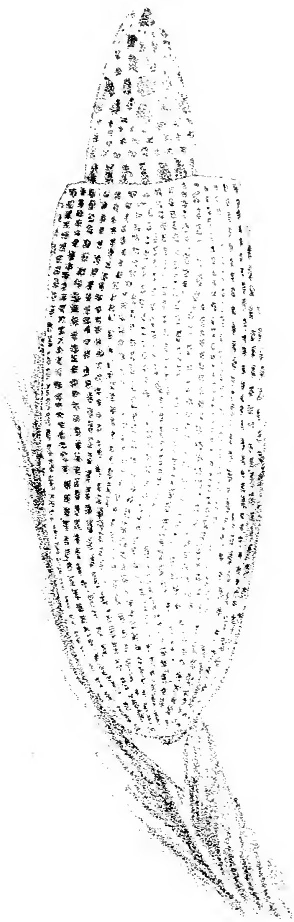
Seed of Stellaria



Trichia



Spiracle-Larva of Stag Beetle.



Egg. Parasite of Ground Hornbill

Wesley Scientific Society.

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E. C. BOUSFIELD, L.R.C.P., etc., Old Kent Road, London, S.E.

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Miss Ripley, Lower Greaves, Lancaster.
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Mosses: R. V. Tellam, Bore Street, Bodmin.
Circulation: Rev. G. Southall, F.R.M.S., Dovercourt, Harwich.

Members who wish to study any of the above subjects are requested to communicate directly with the Referees, who will give all necessary information as to terms and conditions. Those joining will be expected to lend slides or specimens, or else to pay to the Referee the sum of 2s. 6d. yearly.

Only such persons will be admitted by the Referee as have previously paid to the Rev. W. Spiers the sum of 6s. for the year's Journal, which will be sent post free for that amount. Circulation of specimens will commence as soon as possible after January.

LEPIDOPTERA.—Mr. Thresh wishes it to be announced that his last box of specimens has not yet been returned. If any member has this box, he would oblige by returning it to the Referee at once. Any other parcels that are now circulating should be sent in to the respective Referees at once, in order to facilitate the new arrangements.

London Converzazione.—This annual gathering is arranged for Dec. 18 at the Centenary Hall, Bishopsgate St., when John Beauchamp, Esq., of Highgate, takes the chair. We hope to give an account of the proceedings, with Dr. Dallinger's address, in our next number.

Popular Science Lectures.—Local Societies and Clubs desiring the services of Referees for lectures at reduced fees are requested to make application, in the first instance, to the Rev. W. Spiers.

Sale and Exchange.—Members having scientific apparatus for sale should send particulars to Rev. W. Spiers. The following are offered :—

Gas reading-lamp, with solid brass stand, with caps and tubes.
Admiralty Compass.
Small Geological Collection, in cabinet, all named.
Lantern Slides—Fifty Interiors of Cathedrals, $3\frac{1}{4}$ in. square.
A small hand Dynamo and Intensity Coil.

The Wesley Naturalist.—An Index for 1889 has been printed, and a copy is forwarded to all subscribers who receive the present number of the *Journal of Microscopy*. Others who may desire the Index are requested to forward an addressed postal wrapper to the Rev. W. Spiers.

Subscriptions.—A receipt has been sent through the post to every member of the W.S.S. who has paid the subscription for 1890. Anyone who may not have received this acknowledgment is requested to communicate with the Rev. W. Spiers. Those who have not yet sent their subscription, should do so at once, as there will be a difficulty in ensuring the present number of the Journal after the end of January.

Circulation of Periodicals.—Several members having expressed the desire that this department should not drop, the matter is under reconsideration. Those who wish to join this section are requested to apply to Mr. W. Symons, F.C.S., Bilbrook, Taunton, stating what periodicals they would like to receive, and any arrangements that may be made will be announced in the next number of the Journal.

Reviews.

Journal of Morphology. Parts 1 and 2, Vol. III. Edited by C. O. Whitman and Edward Phelps Allis. (London: W. P. Collins. Boston, U.S.A.: Ginn and Co.)

It is with much pleasure that we acknowledge the receipt of the first and second parts of the third volume of this valuable work. They contain long papers on The Actinaria of the Bahama Islands, by J. Playfair McMurrich, M.A., Ph.D.; Contributions to the Comparative Osteology of the Families of North-American Passeres, by R. W. Shufeldt, M.D., M.R.Z.S.; Notes on the Anatomy of Speotyto Cunicularia Hypogœa, by R. W. Shufeldt; and Variation of the Spinal Nerves in the Caudal Region of the Domestic Pigeon, by James J. Peck, A.B. The Mechanical Causes of the Development of the Hard Parts of the Mammalia, by E. D. Cope; and The Embryology of *Blatta Germanica* and *Doryphora decemlineata*, by William M. Wheeler.

These two numbers consist of 386 pages and 21 finely-executed litho-plates, many of them of double-size. The work also contains a great number of woodcuts, and no pains appear to have been spared in making this journal all that could be desired.

Plant Organization: A Review of the Structure and Morphology of Plants by the Written Method. By R. Halsted Ward, A.M., M.D., F.R.M.S., etc. 4to. (Troy, N.Y.: The Author. 1889.)

This scheme is intended as a practical aid to beginners and others in acquiring insight into the structure, kinds, and relations of the few simple members which, by their interesting variations and combinations, make up our familiar plants. The book opens with short accounts of Chart Work, Plant Work, and Laboratory Work, followed by two pages of plates, giving numerous illustrations of Plant Organizations, showing the various forms of Root, Stem, Leaf, Flower, and Fruit. Then we have a Synopsis of Plant Organization. The body of the book is made up of pages ruled with printed headings for plant descriptions, a double page being devoted to the description of each plant. At the foot of each page spaces are left for outline drawings and diagrammatic sketches.

Die Naturlichen Pflanzenfamilien. Edited by A. Engler and K. Prantl. Nos. 35 and 36. Royal 8vo. (London: Williams and Norgate. Leipzig: Wilhelm Engelmann.)

The third volume of this important work is now completed. The parts before us contain descriptions of the following families:—Oleaceæ and Balanophoraceæ, by A. Engler; Aristolochiaceæ, by H. Solereder; Rafflesiaceæ and Hydnoraceæ, by H. Grafzu Solms; Campanulaceæ, Goodeniaceæ, and Candolleaceæ, by S. Schönland; Acrasieæ Phytomyxinæ and Myxogasteres, by J. Schröter.

In these two parts are 76 well-executed engravings, containing 307 figures.

The Birds in My Garden. By W. T. Greene, M.A., M.D. Crown 8vo, pp. 190. (London: Religious Tract Society.) Price 2s.

The subject of the winged visitors to our gardens is very nicely treated in these pages. First we have Inhabitants of My Garden—viz., the Sparrow and Starling; 2nd, Former Residents, now Occasional Visitors at all seasons; 3rd, Occasional Spring and Summer Visitors; 4th and 5th, Autumn and Winter Visitors; 6th, Recent Visitors which have now disappeared; and 7th, Visitors of Foreign Extraction. The list comprises some 28 or 30 birds, all of which are nicely described. The book is neatly bound and well illustrated.

A YEAR WITH THE BIRDS. By W. Warde Fowler. Crown 8vo, pp. xvi.—265. (London: Macmillan and Co. 1889.) Price 3s. 6d.

The aim of the author of this interesting book has been to help those who love birds, but know little about them, to realise something of the enjoyment which he has gained from the habit of watching for and listening to his favourites. His study of birds has been chiefly carried on in Oxford, in a village situate in the Midlands, and a well-known district of the Alps. In the index the scientific names of the birds are given.

IRIS: Studies in Colour and Talks about Flowers. By Franz Delitzsch, D.D. Translated from the original by the Rev. A. Cusin, M.A. 8vo, pp. 227. (Edinburgh: T. and T. Clark. 1889.) Price 6s.

The author tells us that he can scarcely remember the time when he was not irresistibly drawn to observe the refraction of light and to muse on the language of colours. These themes have been collected under the emblematical name, IRIS.

The book is divided into 12 chapters or sections, and treat of The Blue of the Sky; Black and White; Purple and Scarlet; Gossip about Flowers and their Perfumes, etc. etc.

OUR CATS AND ALL ABOUT THEM: Their Varieties, Habits, and Management, and for Show. By Harrison Weir, F.R.H.S. Crown 8vo, pp. viii.—248. (Tunbridge Wells: R. Clements and Co. 1889.)

We have before us a most interesting work, and are assured by the author that it is the outcome of over fifty years' careful and thoughtful observation, combined with much research. Mr. Weir, who certainly ought to know, tells us that the small or large dog may be regarded and petted, but is generally *useless;* the cat, whether a pet or not, *is of service.* Were it not for our cats, rats and mice would overrun our houses, buildings, and lands. If there were not *millions* of cats, there would be *billions* of vermin. The standard of excellence and beauty with respect to cats is here described and pictured.

THE BROOK AND ITS BANKS. By the Rev. J. G. Wood, M.A. Small 4to, pp. 319. (London: Religious Tract Society.) Price 6s.

This is, we are told, one of the last books from the facile pen of the Rev. J. G. Wood. The plan of the book is worked out with all the vivacity of style and copiousness of anecdote and personal experience for which the late Mr. Wood was so justly noted. The reader is conducted along the banks of an English brook, and taught in the pleasantest of ways how to discover and observe many living creatures which live either in the water or along its banks.

The volume is handsomely got up and well illustrated.

FLOWER-LAND: An Introduction to Botany. By Robert Fisher, M.A. Post 8vo, pp. viii.—240. (London: Bemrose and Sons. 1889.) Price 4s. 6d.

Readers of this little book may hope to find in it a sound, if only an elementary knowledge of Flowering Plants. It is also arranged so as to serve as an introduction to more advanced text-books for those who wish to enter more thoroughly into the science. We quite agree with the author in strongly advising both teachers and pupils to study the book with the actual plants alluded to in the hand at the time. A pocket magnifier will prove an additional help. The book is very nicely illustrated.

THE PREPARATION AND MOUNTING OF MICROSCOPIC OBJECTS. By Thomas Davies. Edited by John Matthews, M.D., F.R.M.S., etc.

Fifteenth thousand. 12mo, pp. viii.—214. (London: W. H. Allen and Co. 1890.) Price 2s. 6d.

It is always a pleasure to us to welcome a new edition of this useful little book, and we would recommend all who do not already possess a copy to lose no time in securing one.

We cannot at this moment place our hands on an earlier edition, but we do not notice any material alterations in the new copy.

Mr. Mygale's Hobby: A Story about Spiders. By the Author of "The Glory of the Sea," "Swallow-tails and Skippers," "The Greek Auk's Eggs," etc. Post 8vo, pp. 192. (London: The Religious Tract Society. 1889.) Price 2s.

Boys who wish to know anything about spiders would do well to read this book. Mr. Mygale (the name is, of course, assumed) is devoted to the study of these interesting creatures, and describes them in a most attractive manner to his young friend, who in a short time becomes as enthusiastic as his teacher. At the end of the book is an Appendix, giving a full table of all British Spiders, divided into tribes, families, genera, and species.

The Playtime Naturalist. By Dr. J. E. Taylor. (*London: Chatto and Windus.*)

Dr. Taylor's fascinating style of writing on natural history is known to all our readers. This new volume is specially designed for young people, and is sure to be read by such with eager interest. It is no small privilege for the beginner in natural history studies to be led by such a master through the various domains of Nature, and to have pointed out and described in language non-technical and conversational some of the most beautiful things that lie within our reach, but which, for want of a suitable Mentor, are unknown to so many. A good deal of the book is written for those who have some sort of a microscope, and is concerned with diatoms and infusoria, while there are also chapters on birds and reptiles, shells and butterflies, the whole constituting a most charming introduction to the fairyland of science.

The Butterfly: Its History, Development, and Attributes. By John Stuttard. Crown 8vo, pp. 92. (London: T. Fisher Unwin.) Price 1s.

Written in a simple, racy style, and will be read with interest and profit by those who take an interest in the pretty insect. Some may be disappointed to find that the author shows that the parallel between the change that takes place in the butterfly and our resurrection bodies is not a just one, and that if there is any analogy it is that of contrast rather than of resemblance.

Glimpses of Animal Life. By William Jones, F.S.A. (*London: Elliot Stock.*)

To many readers these observations on the habits and intelligence of animals will be very interesting and serviceable. It is an almost complete *repertoire* of facts and records concerning animal sagacity. We are all familiar with the results of training in the case of such animals as the dog, horse, elephant and the lively *pulex*; but it will astonish some to be told that fishes are extremely susceptible to the charms of music and that the pig has been taught arithmetic (p. 84). There are also some good chapters on luminous fishes and on the curiosities of nesting. It is a book to teach us all to keep our eyes open. It is a pity, though, that the author has not followed some sort of zoological method in dealing with the many animals he passes in review. This would have made reference a much easier matter. It is rather discomposing to the naturalist to find himself obliged to skip up and down the zoological ladder almost at random. And there is no index to tell one when he has found out all there is to be got concerning any particular animal.

Manuel de Phototypie. Par M. G. Bonnet. Post 8vo, pp. x.—146. (Paris: Gauthier-Villars et Fils. 1889.)

Without confining himself to any particular inventor's system of mechanical printing, the writer describes a practical process which he strongly recommends to photographers as being in many respects superior to the usual methods of multiplying photographic proofs on silver or platinum paper.

Le Temps du Pose. Par A. de la Baume Pluvinel. Post 8vo, pp. viii.—141. (Paris: Gauthier-Villars et Fils. 1890.)

The various factors which contribute to correct exposure are here subjected to a rigid mathematical investigation, and the results embodied in a series of 16 tables.

Chess Studies and End Games. By B. Hortwitz and J. Kling. Second edition, revised by W. Wayte, M.A. 8vo, pp. vi.—376. (London: G. Bell and Sons. 1889.)

The work before us is divided into two parts. Part I., Chess Studies by Messrs. Hortwitz and Kling; Part II., Miscellaneous End Games by B. Hortwitz. Lovers of the games will find much in this volume to instruct them, and we think the student will do well to study the numerous end games in which it frequently happens that more than one solution is given. It is needless to add that the volume is illustrated with a very large number of diagrams.

Our Dumb Companions; or, Conversations about Dogs, Horses, Donkeys, and Cats. By Thomas Jackson, M.A. Sm. 4to, pp. 112. (London: S. W. Partridge and Co.) Price 2s.

This is a well-illustrated and a very interesting book for our young people. It is written throughout in the form of a conversation between a father and his children, aud cannot fail to interest any of our young friends who may be sufficiently fortunate to possess a copy.

Bibliotheca Debyana. Being a Catalogue of Books and Abstracts relating to Natural Science, with special reference to Microscopy, in the library of Julien Deby, M.E., F.R.M.S., etc. Cr. 4to, pp. 151. (London: The Author. 1889.)

This catalogue, although prepared expressly for the convenience of the author, will be found a very valuable addition to any scientific library. It is divided into three sections—I., Serial and Periodical Publications; II., The Microscope and its Technicalities; III., The Protozoa. The work is handsomely got up; neither labour nor expense appears to have been spared in its production.

Hazell's Annual for 1890: A Cyclopædic Record of Men and Topics of the Day. Cr. 8vo, pp. 712. (London: Hazell, Watson, and Viney. 1890.) Price 3s. 6d.

This is the fifth yearly volume of this exceedingly useful cyclopædia, and contains above 3,500 concise and explanatory articles on every topic of current, political, social, biographical, and general interest referred to by the press and in daily conversation. It is edited by C. D. Price, F.G.S., and we feel bound to say that no efforts have been spared to make the work very valuable for reference on every subject of general interest.

The Journal of Indian Art. Nos. 22—28. (Published by W. Griggs, Elm House, Peckham, London.)

These handsomely illustrated numbers contain articles on the Wire-Inlay of Mainpuri and Chiniot, by F. S. Growse, C.I.E., with 14 plates; The Industries of the Punjab, by J. L. Kipling, C.I.E., with 12 plates; Silk Industry in the Punjab, 1886-7, by H. C. Cookson, C.S.; Phulkari Work in the Punjab, by Mrs. F. A. Steel, with 15 plates; The Arts and Manufactures of Ajmere-Merwarra, by Surgeon-Major T. Holborn Hendley, with 29 plates; The Industries of Madras, by E. B. Havell, with 14 plates; The Art Industries of Nepal, by G. H. D. Gimlette, Reisdency Surgeon, with 15 plates.

This is truly a magnificent work; it is published under the patronage of the Government of India. London agent: B. Quaritch, Piccadilly.

RESEARCHES INTO THE LOST HISTORIES OF AMERICA. By W. S. Blackett. (London: G. Trubner and Co.) 8vo, pp. viii.—336. Illustrated by 17 engravings.

The writer seeks to show that America was well known to the ancients, and that the zodiac is a map of the ancient world rather than of the stars, and that in that map America holds a prominent position. This work exhibits a large amount of thought and research.

THE ZOO (Second Series). By the Rev. J. G. Wood. 4to, pp. 60. (London: Society for Promoting Christian Knowledge.) Price 2s.

Interesting accounts are here given of the Stoat, Weasel, Badger, and Honey-Ratel, the Common Seal, the Squirrel, etc.; Beavers, Porcupines, the Kangaroo, Chinchilla, Jerboa, and Musquash, Hamster and Lemming, the Guinea-Pig, Capybâra, Agouti and Paca, the Zebu, Buffalo, Bison, and Gour.

HISTORY OF CALIFORNIA. Vol. III. Roy. 8vo, pp. xvi.—792. (San Francisco: The History Publishing Co. 1886.)

This vol. forms No. 20 of Bancroft's Historical Works. It gives the history of California from 1825 to 1840, and supplies a large amount of most interesting and valuable information, telling us of the revolt of the soldiers, the beginning of the influx of foreign hunters overland, the driving out of the governor, and secularisation of the missions, the revolt of Alvarado, and the campaign between the North and the South. This volume contains a continuation of the Pioneer Register; this is an alphabetical list, covering some 60 pages, and gives a short history of each person mentioned.

We consider it would be impossible for any history to be more thoroughly and conscientiously carried out than has been done by Mr. Bancroft in this grand work, of which this volume is one of a large series.

UP NORTH IN A WHALER: or, Would he Keep his Colours Flying? By Rev. Edward A. Rand. Post 8vo, pp. 350. (New York: Thos. Whittaker. 1889.)

This is one of a capital series of books known as the "Look Ahead Series," and in noticing it we think we cannot do better than make a short extract from the preface:—"It is a story in part only. Woven into its fabric are threads from the fascinating texture of Arctic life, and heroism shown in Arctic exploration. While such information is given, there is an account of English Arctic Whaling." "Beyond these Arctic data, and any interest the book may have as a story, I trust its leading idea has value to show how character well grounded in Christian principles may be expected to be an abiding structure. If the colours of the Right are flying at the mast-head of youth starting out on life's voyage, they will not be likely to come shamefully down." We heartily commend this book.

Jack and his Ostrich: An African Story. By Eleanor Stridder. Cr. 8vo, pp. 192. (London: T. Nelson and Sons. 1890.)

This tale gives a most interesting account of the life of a small sheep-farmer in the wilds of Africa. Jack is a fine, manly little fellow, and his chief and almost only companion, a tame ostrich, proves a faithful friend, acting both as house-dog and pony to his young master. We are sure that all lads who may have the opportunity of reading this book will do so with much pleasure; few books of the kind have interested us more.

The Conquerors of the World. Being a Popular Account of the Peoples and Races of Europe, their History, Ethnology, Manners, and Customs. By G. T. Bettany, M.A., B.Sc., F.L.S., etc. Cr. 8vo, pp. xii.—279. (London: Ward, Lock, and Co. 1889.) Price 2s. 6d.

This interesting and instructive little book traces the inhabitants of Europe from the earliest times; it is divided into 22 chapters, and treats of the Early Inhabitants of the British Islands, Historic Britons, The Britons of To-day, France in the Past and Modern France, The Spaniards and Portuguese, Italians of the Present Day, etc. etc. The usefulness of the book is much enhanced by an immense number of illustrations. The subject of each paragraph is stated in heavy type in the margin.

Echoes from Japan. By M. McLean. Cr. 8vo, pp. 315. (London: Passmore and Alabaster. 1889.) Price 3s. 6d.

Some of these "echoes" give the reader a simple and honest description of child-life in Japan; others tell very forcibly what travellers see and feel in visiting the various places of interest.

Livingstone Anecdotes. By Dr. Macaulay. pp. 190. (London: The Religious Tract Society.) Price 6d.

We can confidently recommend this book to anyone about to purchase books for prizes in Sunday or Day Schools. It is bound in cloth boards, and is well worth its cost, sixpence. Livingstone's Life and Travels are written in such a simple, interesting style, that the young person who gets this book will not only value it as a prize, but, what is more uncommon, will read it.

Elements of Physiography. By John J. Prince. Crown 8vo, pp. 175. (Manchester and London: John Heywood.)

This little book has been written with special reference to the syllabus issued by the Science and Art Department. The information is accurate and up to date. The diagrams are very clear, and contain no unnecessary lines or figures. The writer is evidently a master of his subject, and has written a book which will be most useful to anyone who is about to be examined in Physiography.

Narrative of an Explorer in Tropical South Africa; also Vacation Tours in 1860-61. Crown 8vo, pp. 320. (London: Ward, Lock, and Co.) Price 2s.

This volume is one of the Minerva Library of famous books, and well deserves a place among books that will live. 214 of its 320 pages are written by that well-known explorer and writer, Francis Galton, and describe his visit to Damaraland in S. Africa. The remainder of the book contains an account of a visit to North Spain, at the time of the Eclipse in 1860, by Francis Galton; a Visit to Nabloos and the Samaritans, by Sir George Grove, D.C.L.; and a Visit to Naples and Garibaldi, by the late W. G. Clark, M.A.

This volume is cheap and good, a combination by no means universal.

LADY MISSIONARIES IN FOREIGN LANDS. By Mrs. E. R. Pitman. Post 8vo, pp. 160. (London: S. W. Partridge and Co.) Price 1s. 6d.

This book contains a short, interesting sketch of the lives of Mrs. Ann Judson, of Burmah; Mrs. Johnson, of the West Indies; Mrs. Gobat, of Abyssinia and Jerusalem; Mrs. Wilkinson, of Zululand; and of Mrs. Cargill, of the Friendly Islands and Fiji.

These ladies, unlike many of the lady Missionaries of the present day, were all the wives of Missionaries, and were admirable help-meets to their husbands in Missionary work. The book is illustrated with portraits of these ladies, and also views of places in which they laboured. The book is calculated to stir up others to follow in the footsteps of these pioneers of Mission work.

THE GREAT AUTHORS OF ENGLISH LITERATURE. Crown 8vo, pp. 810. (London: Nelson and Sons. 1889.) Price 3s. 6d.

This book gives the lives and specimens of the productions of the Great Authors of English Literature, from Chaucer to Macaulay and Browning. It is divided into three parts. The first from Chaucer to Pope; the second from Goldsmith to Wordsworth; and the third from Macaulay to Browning.

The lives of the authors are short but clear, and the account of the works is instructive and helpful. The specimens of the authors' works fairly represent the style and ability of the writers, though, of course, they are not always those that the reader may think the masterpieces. No one can read this book without profit.

EARTHQUAKES. Translated from the French of Arnold Boscowitz. By C. B. Pitman. Post 8vo, pp. xviii.—395. (London: George Routledge and Sons. 1890.) Price 5s.

A very interesting and instructive book, on a rather uncomfortable subject. It gives a history of Earthquakes from that which seems to have destroyed Sodom and Gomorrah, up to those which happened in 1884 in Ischia and Andalusia. The author discusses various theories with regard to the causes of Earthquakes. The book is plentifully illustrated, and most of the illustrations are exceedingly good.

BANCROFT'S WORKS, Vol. XXXVII.: POPULAR TRIBUNALS, Vol. II. Roy. 8vo, pp. viii.—772. (San Francisco: The History Publishing Company. 1887.)

This fine work is the second of the series treating on Popular Tribunals. In Vol. I., which we noticed in our last issue, a few chapters were devoted to law, justice, and tribunals; the narrative was taken up at the period of the discovery of gold in California, it was then continued up to the year 1856, when it was followed into other cities. The volume before us is devoted in a great measure to the Grand Tribunal of San Francisco in 1858, which was perhaps the largest and most important of the kind the world has ever known.

In this volume, as in all others of the series, we are struck with the masterly powers exhibited by the great historian.

ANNUAL OF THE UNIVERSAL MEDICAL SCIENCES: A yearly report of the Progress of the General Sanitary Sciences throughout the world. Edited by Charles E. Sajous, M.D., and seventy associate editors. 5 Vols. Roy. 8vo. (Philadephia, New York, and London: F. A. Davies. 1889.)

This important work has for its object to review the progress of Medicine of the Universe; the volumes before us form the second of the series, the first being published in 1888.

Many improvements which have suggested themselves have been made in this series—*e.g.*, Foreign Weights have been reduced to those more generally used—grammes to ounces, drachms, grains, etc., and Centigrade degrees to Fahrenheit, both appearing side by side. An Index has been added to each volume, besides the complete triple index at the end of the entire work, which alone occupies 101 pages. Two departments have been added: "Examination for Life Insurance," and "Railway Neuroses." The general appearance of the entire work has been much improved.

A Monthly Journal called "THE SATELLITE," is issued to the subscribers of this work.

THE ILLUSTRATED MEDICAL NEWS, NOS. 52 to 63. (Office: 48 Queen Victoria Street, E.C.)

This important Journal keeps up its well-merited fame. In addition to original articles, each number contains Leaders and Leaderettes. Amongst the Lectures published in recent parts have been the Series of Croonian Lectures "On the relationship between Chemical Structure and Physiological Action," by T. Landor Brunton, M.D., D.Sc., LL.D., etc. "The Harveian Lectures on the Surgery of the Kidneys," by J. Knowsley Thornton, M.C., etc., "Gleanings from the Societies," &c. &c.

Each number contains a fine-coloured plate, and a number of wood and other engravings.

AN INTRODUCTION TO CHEMICAL SCIENCE. By R. P. Williams, A.M., and B. P. Lascelles, M.A., F.C.S. Post 8vo, pp. viii.—223. (London: Ginn and Co. 1889.) Price 3s. 6d.

Although this is not what is generally understood as a Text-book of Chemistry, it gives a very complete outline of the science, and will consequently doubtless prove of much value to the student. The body of the work is divided into sixty chapters, treating more or less on all subjects to which the student is required to give his attention. It is nicely illustrated.

A GLOSSARY of Anatomical, Physiological, and Biological Terms. By the late Thomas Dunman. Edited and supplemented with an Appendix by V. H. Wyatt Wingrave, M.R.C.S., etc. Crown 8vo, pp. 187. (London: Griffith, Farran, O'Keden, and Co. 1889.)

This book will be found most useful to the student; it gives the pronunciation, derivation, and definition of all those terms usually employed in Biological Science. The accented syllable in each word is marked, and when necessary the long and short vowel-signs are given. We notice also that letters silent in pronunciation are printed in italics. The Greek roots where given are printed in English characters, which we consider a great advantage, and we trust the book will be found useful for students preparing for the examinations of the Science and Art Departments and other examining bodies.

THE CAUSES, TREATMENT, AND CURE OF STAMMERING. By A. G. Bernard, M.R.C.S., L.R.C.P. Post 8vo, pp. vi.—71. (London: J. & A. Churchill. 1889.) Price 2s.

This book is not the production of a "Quack," but of a Physician, who having been an inveterate stammerer himself, describes briefly, but clearly, the method by which he cured himself. The method of cure seems simple and certain, provided always that the patient has the patience, perseverance, and resolution of the writer. Unless the stammerer has, or endeavours to acquire, the above virtues, we fear that, in spite of this or any other method of cure, he will stammer still. However, what man has done, man may do, and we trust that some of the thousands of stammerers of our land may have the writer's perseverance and success.

BUXTON: its Baths and Climate. By Samuel Hyde, L.R.C.P., M.R.C.S. Crown 8vo, pp. xiii.—134. (Manchester: John Heywood. 1889.)

We have in this book a full account of the celebrated waters and climate of Buxton, and a description of "The Buxton Thermal Cure," a new method of carrying out the Buxton Treatment, with special chapters on Baths, Bathing, and Massage; also excursions round Buxton and the Peak. In this portion of the work we have a description of Buxton in the past, the favourite walks around Buxton, and six excursions in the neighbourhood. A map of the town of Buxton is added to the book.

THE CRUISE OF THE BETSEY; or, a Summer Holiday in the Hebrides. With RAMBLES OF A GEOLOGIST; or, Ten Thousand Miles over the Fossiliferous Deposits in Scotland. By Hugh Miller. Cr. 8vo, pp. iv.—486. (Edinburgh: W. P. Nimmo. 1889.) Price 3s. 6d.

A cheap and most interesting book, containing the account of a summer ramble among the Hebrides by a well-known geologist. The book is readable and instructive, and is written in such a simple, lucid style, that it cannot fail to be read with pleasure even by those who know nothing of the science of which the author was so distinguished a master.

THE DOUBTS OF DIVES. By Walter Besant. (Bristol: J. W. Arrowsmith. London: Simpkin, Marshall, and Co.) Price 1s.

A novel in Mr. Besant's well known and much appreciated style. It is healthy and stimulating to a higher life than that of mammon worship.

JANE EYRE. By Charlotte Brontë. pp. 383. (London: Walter Scott, 24, Warwick Lane. 1889.) Price 1s.

This is one of the Camelot Series. It is needless to say anything in praise of a book that retains its popularity for nearly 50 years after its first publication.

VICTIMS TO CUSTOM: A Temperance Tale. By Emily Foster. Cr. 8vo, pp. 285. (Manchester: Brook and Chrystal. London: Simpkin, Marshall, and Co. 1889.) Price 2s. 6d.

This is an interesting and instructive tale, and one well calculated to enlist the sympathies of its readers for the temperance cause.

TWO OLD TALES RETOLD. By Mona Noel Paton, illustrated by Hubert Paton. 4to, pp. 110. (Edinburgh: Banks and Co. London: Simpkin, Marshall, and Co.) Price 3s. 6d.

The two tales are "Beauty and the Beast" and "Jack the Giant Killer." Both stories, but especially the first, are told in a novel and interesting way. The moral of the first is that the Beast loses his ugliness by trying to be good; and of the second, that we ought all to be giant-killers under the inspiration of the virgin conscience.

THE ENCORE RECITER. Edited by F. E. Marshall Steele. pp. 128. (London: F. Warne and Co.) Price 1s.

Contains about 90 readings from authors grave and gay. The authors are all well known and justly celebrated, and the selections are likely to justify the title of the book.

TEMPERANCE HISTORY. By Dawson Burns, D.D. pp. 222. Paper covers. (London: National Temperance Depot.) Price 2s.

This is the first part of a History of Temperance, which is to be completed in four parts. The present part embraces the period from the commencement of the Temperance movement, in 1829, to 1842. The information is full, clear, accurate, and authoritative, and the work, when completed, will be invaluable to the student or lecturer.

A New Geography on the Comparative Method. With maps and diagrams. By J. M. D. Meiklejohn, M.A. Second edition, crown 8vo, pp. 50—492. (St. Andrew's: A. M. Holden. London: Simpkin, Marshall, and Co.)

The merit of this book is that its style is simple, and therefore can be easily understood and retained; and also connected, and therefore can be readily reproduced.

Everything that type of various sizes and clear maps and diagrams can do to facilitate the acquisition, retention, and reproduction of geographical knowledge of all kinds has apparently been done, or at least attempted, in this volume, and we have no hesitation in saying that the student who has mastered it will have little cause to fear failure in the Oxford and Cambridge Local Examinations.

A Primer of Cursive Shorthand. By Hugh L. Callendar, M.A., Fellow of Trinity College, Cambridge. (London: C. J. Clay. 1889.) Price 6d.

This system of shorthand appears to be known as the Cambridge system. From specimens of the style given, we notice that the characters appear to flow into each other with great ease, but we regret that we are unable to compare it practically with other and better-known systems.

Illustrations. By Francis George Heath.

The Christmas number of this work is an excellent one, and contains several good seasonable tales, besides other articles. The illustrations, which form a conspicuous portion of this serial, are well executed. With this number also is given a large presentation plate.

Travel, Adventure, and Sport. From *Blackwood's Magazine*. Nos. 4 and 5. (London and Edinburgh: Blackwood and Sons.) Price 1s. each.

These are good shilling's worths. They contain a journey from Herat to Orenburg on the Caspian, by Sir Richmond Shakespear; The Inland Sea of Japan, by Andrew Wilson; A Run to Nicaragua, by Laurence Oliphant; Up Stream on the Red River; A Reindeer Ride through Lapland, by F. Taysen; The Valley of the Shadow of Death, by Andrew Wilson; A Night's Peril; Marquines and La Collegiala; A Cruise up the Yangstze in 1858—9, by Admiral Sherard Osborne.

The fact that these travels found a place in *Blackwood's Magazine* will, with most people, be a sufficient guarantee that they are written by competent men, and therefore trustworthy as well as readable.

Tales from Blackwood, No. 5. pp. 218. (Edinburgh and London: W. Blackwood and Sons.)

Two deeply-interesting tales, which have appeared in the pages of *Blackwood's Magazine*. They are entitled "A Singular Case," by F. S. Dollenbaugh, founded on that peculiar mental disease known to the medical profession as "Aphasia"; and "Pentock," by Miss M. Bradley. A good shilling's worth.

W. P. Collins' Scientific Catalogue.—The December issue now before us is devoted to works on Microscopy, including Petrography, and offers a large number of rare and valuable works, many very scarce.

Messrs. Wesley and Son have issued No. 98 of their "Natural History and Scientific Book Circular," dealing with Ornithology, Mammalia, and Geography.

The Parasitic Fungi of Insects.

By George Norman, M.R.C.S., F.R.M.S.

Plates 6, 7, and 8.

THE Fungi of Insects may be roughly divided into two classes, according to their method of obtaining nutriment :—

1.—Those which obtain their nutriment entirely from living hosts, whether animal or vegetable, and which are called Parasites.

2.—Those which live entirely on dead organic matter, whether animal or vegetable, and which are termed Saprophytes.

Between these two extremes, however, there are numerous gradations—such, for instance, as where a *parasite* grows upon and kills its host, and then continues to vegetate as a *saprophyte* upon the dead tissues.

The Parasitic Fungi affecting plants are exceedingly numerous, but those affecting insects are comparatively few, though important in some cases, at least from an economic point of view.

The Fungi parasitic on insects, although formerly assigned to one or other of the older and well-known groups, have of late years, as their life-history has become better known, been placed in groups by themselves, adjacent to, but not belonging to the old divisions.

Thus the Entomophthoreæ, formerly included in the Torulacei, are now placed in a separate group, adjacent to the Mucorini ; whilst another group, the Laboulbenieæ, formerly included in the Ascomycetes, are now tentatively placed along-side them. There is, however, one important exception, in the case of Cordyceps or Torrubia, which, at any rate for the present, retains its place amongst the Ascomycetes.

Laboulbenieæ.

This group, more nearly allied to the Ascomycetes than to any other family, presents numerous peculiarities quite entitling it to a separate position. The members of this group, though parasitic, do not appear to be particularly harmful to their hosts as a rule. They are generally found on the elytra and outer surfaces of beetles, which live either in or near water; one species, however, is found affecting the common house-fly.

The usual appearance is that of small brown brushes studded over the surface of the insect, but sometimes these grow so close to one another as to give the appearance of the insect being enclosed in thick fur.

Each plant consists of a filiform, or club-shaped stalk, supporting a conical or flask-shaped body (the perithecium), which contains a variable number of spore cases (asci), and each of these in its turn contains from eight to twelve spores. Attached to the base of the perithecium is a peculiar filamentous body, called the appendage, the use of which is not known.

The ripe spores are fusiform, colourless, and bi-cellular; they are liberated by the gelatinous deliquescence of the wall of the ascus, and escape through the orifice of the perithecium.

The spore, on its escape, attaches itself by one extremity to the chitinous covering of the insect, and sends into it a small short tube, which sometimes enlarges into a knob at its extremity. Thus firmly planted, it develops at right angles to its basis, and eventually reaches its mature state by the necessary successive cell divisions and differentiations.

There is no mycelium, but the spores, being very small and very numerous, are easily conveyed from one insect to another. This is as much as is known of the life-history of this fungus, which is entirely confined to the external surface of the body of the insect, and does not seem to be detrimental to the health of the host.

ENTOMOPHTHOREÆ.

The fungi of this group differ from the last in several ways. They seem more allied to the Mucorini than to the Ascomycetes, and they are much more destructive to their hosts, for they penetrate into the cavities of the bodies of living insects, and there develop. There are two principal genera of this group—viz., Empusa and Entomophthora. In the Empusæ numerous detached and spherical cells are formed by repeated sprouting from the germ tube, which has penetrated through the skin into the interior cavities of the insect, and each cell as the insect dies develops into a long tube containing much protoplasm. This tube pierces the skin, grows outside it into a short club-shaped body, at the end of which is produced a single spore. This club-shaped body, or basidium, is connected with the spore by a narrow neck, and at this point is formed a cross-septum separating the one from the other. The membrane of the basidium is highly elastic, but its cohesion is less over an annular zone immediately beneath the cross-septum, than at any other part. The consequence is that, as tension increases, consequent on the continuous absorption of moisture by the basidium, there comes a time when it overcomes the resistance of the less coherent annular zone, the wall opens by a circular fissure, the pressure is at once relieved, and the elastic wall of the basidium contracts, especially in the direction of the transverse diameter, and this causes a large quantity of the fluid contents of the basidium to be squirted out with great force through the fissure, striking full on the transverse septum, and carrying the spore with it. Sometimes in Empusa the ripe spores are thrown to a distance of 3 c.m., and adhere by the remains of the ejected protoplasm to the bodies against which they strike.

These spores, or conidia, emit a germ-tube, which is capable of penetrating at once into the body of a suitable host, and so repeating the process of development already described. If supplied with sufficient moisture the spores produce short tubes, from the extremities of which secondary spores, or conidia, are produced, capable of undergoing the same development as the primary ones. These spores, or conidia, preserve their power of germinating during a period of about fourteen days.

In Entomophthora, numerous branches of the entozoic mycelium appear on the surface of the body of the insect it has killed, and there ramify in so copious a manner that they soon wrap it in a close felt. At the end of each of these ramifications a spore, or conidium, is formed just as in the manner described in Empusa, and is thrown off in the same way by abjection, as it is called.

The whole strength of the protoplasm is expended in forming the spores, so that the mycelium within the body of the insect shrinks and disappears, and at last there is left only a shrivelled and dried mummy.

The reproductive process described both in the case of Empusa and Entomophthora is a purely vegetative, or asexual one; there is another, or sexual process sometimes observed. The cells of adjacent tubes of mycelium develop an H-shaped union by means of the necessary processes, and establish an open communication at the point where the processes are in contact with one another. Then a spherical protuberance appears near the point of union, which gradually receives the entire protoplasm of the conjugated cells, becomes isolated by a membrane, and finally forms the zygospore, or resting spore. This in due time emits a short tube, the promycelium, which forms conidia in the manner previously described. Sometimes also parthenogenesis takes place—*i.e.*, there is no formation of antheridial or male branches, yet the resting spore is produced just the same.

In all this we have some resemblance to the life-history of fungi parasitic on plants and also to that of Saprolegnia; but here I have to retract some observations which I made in my paper on Saprolegnia some years ago.* In that paper mention was made of a supposed genetic connection between Empusa and Saprolegnia; but in the light of recent investigation it is found that Empusa does not develop into Saprolegnia on any occasion, and the statement may be, in fact, placed in the romance of mycology.

The Entomophthoreæ are parasitic on numerous insects, and as such serve a very useful economic purpose in nature in the destruction of noxious insects. For instance, locusts are rapidly attacked by these fungi, and so certain and rapid is the course of development that death results in about twenty-four hours after the first indication of the attack.

One species, *E. Planchoni*, attacks the aphis, and in connection with this a very interesting point has been raised—viz., whether this special parasite of the aphis might not be got to prey upon the phylloxera, the great destroyer of the vines. Experiments tried with this view have so far been unsuccessful; but it would be a great thing if a destructive agent like this could be converted into a powerful auxiliary of agriculture.

* See *Journal of Microscopy*, 1883, p 185

The Entomophthoreæ do not live exclusively on insects, for one species has been found parasitic on the cells of the prothallus of ferns, and another is parasitic on various species of the fungus Tremelliaceæ. There is, however, a great deal of work to be done before the limits of this group are defined. For instance, amongst the latest investigations, it has been found that a parasite on *Aphis Mali*, hitherto placed among the *Gregarinidæ*, really belongs to this group. Also, many different caterpillars seem to be infested by separate species of Entomophthora, each of them peculiar to one special genus or species of caterpillar. Thus, one species has been found on the caterpillar of *Euchelia Jacobeæ*, the conidial spores of which form small masses of saccharine aspect upon the hairs of the infected caterpillars—hence the name, *Entomphth. saccharina*. These caterpillars feed on a species of Senecio, and were found dead, attached to the branches of the groundsel, head downwards, but sometimes also in a normal position.

Another species—*E. Plusiæ*—destroyed a great many caterpillars of *Plusia gamma* in France last year. The infected caterpillars presented a velvety aspect, like that of certain plants with succulent hairs; but the integuments presented a very wrinkled appearance from the growth of the tufts of hyphæ.

An acarus was also very abundant on these infected caterpillars, which probably assisted in the propagation of the fungus by transporting its conidia.

The oaks in the Garden of Acclimatisation in the Bois de Boulogne were largely infested during the summer by the caterpillars of *Liparis chrysorrhea;* but these in their turn were to a great extent destroyed by an Entomophthora, called *Metarhizium chrysorrheæ*. In this case the external aspect of the caterpillars was but little altered. They only appeared a little indurated and shrivelled, and the hairs had a slightly powdery aspect. They were, however, full of hyphæ of a brownish colour, terminated by small irregular conidia, which often contained some small oily globules.

Still another species from France, which was found in the woods of Meudon during the month of October. It was found on a rare *Orthopteron Leptophyes punctatissima*, which lives upon elms, and arrives at the adult state quite late in the season—

hence the name *Metarhizium Leptophyei.* The insects were found attached to the lower surface of the leaves, parallel to the median vein, and with the head turned towards the petiole. The ventral surface of the insect was covered with hyphæ, causing its adherence to the leaf. The mycelium is pluricellular, and the spores are of two kinds—very small, ovoid conidia, and larger elongated ones, divided by a transverse septum.

Another species has a peculiar life-history. It attacks a Calliphora, and it appears that only one form of its spores are developed in this host, germinating in the digestive tube of the fly. The Calliphora is a favourite food of frogs and lizards, and it is only after it has been devoured that the second more perfect spore is developed in the excrement of the animal that has devoured it.

There is a great deal to be learned yet about this interesting group of fungi, which has so long been serving a great and hitherto hardly recognised service to Nature's economy by ridding it of a superabundance of one form of animal life, which, if not checked by this and other means, would soon destroy vegetable life from the surface of the globe.

CORDYCEPS.

This insect fungus still retains its place among the Ascomycetes, although the knowledge of its life-history has become much more full since first it was placed in this group, when it was known under the name of Torrubia. Several species of Isaria—formerly supposed to belong to a totally distinct genus—are now found to be merely a phase in the life-history of Cordyceps; consequently, we have here an interesting example of dimorphism.

The perfect form of Cordyceps affecting insects consists of a club-shaped body, of a colour varying from red or orange to brown, containing numerous sacs or ascospores, filled with numerous filiform spores, which break up on their ejection into numerous round secondary spores. These, on coming in contact with any moisture, swell and put out germ-tubes which penetrate the skin of a suitable host, if they come in contact with it and ramify in the superficial tissues of its body. After a time, numerous long spores, called cylinder conidia, are produced on the tubes of the mycelium, which, becoming detached, pass into the blood-cavity of the host, when they become elongated and eventually broken up into long conidia as before. They grow at the expense of the blood of the insect until it is so diminished in quantity and deteriorated in quality that the insect is exhausted, becomes soft and shrivelled, and soon dies.

As soon as death takes place, these conidia develop into copiously-branching hyphæ at such a rate that the caterpillar or pupa regains its original size. A body is thus formed in a day or two retaining the shape of the living insect, but consisting almost entirely of a felted mass of mycelium, with some small remains only of the tissues of the unfortunate victim.

This fungus mass, in the form of an insect, has the power of reproducing the coloured, club-shaped bodies with which we started, and this it can do in a few weeks' time, under favourable conditions as to warmth and moisture. If, however, it is exposed to drought and severe cold, it may remain quiescent for months until such time as more favourable conditions prevail. There is, however, an important point to be noticed here. Supposing that these spores do not find a suitable host, when conditions for germination are favourable, they yet have the power of producing the simple conidial spores, which may accordingly be found growing on grass, dead flowers or twigs, decaying furze, etc.; accommodating themselves, in fact, to a parasitic or saprophytic life, according to circumstances. You will at once see that this simple conidial form corresponds to the Isaria previously mentioned as formerly supposed to belong to a different genus; but as a matter of fact it is only waiting the supply of a suitable host to develop into the perfect club-shaped Cordyceps. If no suitable host is found, the simple form probably perishes after a time; but how long it may last is a matter of uncertainty at present.

To throw a little light on the life-history of this genus, we may look at that of *C. ophioglossoides*, which, however, is not parasitic on insects, but on the truffle.

The Isaria, or simple conidial form, is perfected early in the season, and is capable of reproducing itself by its own spores or conidia. Later in the season the same mycelium which has produced the Isaria, produces the Cordyceps or perfect fungus, and this, as we have seen, produces asci and filiform spores. These spores are well protected, being placed within sacs or asci, which again are enclosed in the perithecia, which are themselves embedded in the stroma of the club-shaped end of the Cordyceps, and are thus able to withstand the vicissitudes of winter. When the spring comes, the stroma softens, the mouths of the perithecia open, the asci sail out and burst, and the chains of spores are set free in the air. These chains of spores soon fall to pieces, and each spore, full of vitality, is capable of producing afresh, not a Torrubia, but the Isaria form. How small these spores are may be judged from the fact that, according to Worthington Smith, it would take two hundred millions of them to cover a superficial inch, and that each plant of Torrubia is capable of setting free at least ten millions of these reproductive bodies every spring.

All the insect-killing species of Cordyceps have the same life-history, including the fungus of Muscardine, the disease of the silkworm caterpillar, formerly known as *Botrytis Bassii*. When the spores of this fungus fall on a healthy silkworm, they at once germinate, and in a period varying from 70—140 hours (depending on the age of the caterpillar) fresh spores are formed, and the disease is spread from a fresh centre.

The silkworms do not appear to be diseased, and they eat with avidity; but they die quite suddenly in a few days. It is very difficult to get rid of the disease from the breeding-houses when once it has broken out in them. The only way is to completely empty the houses and burn the contents, and then disinfect them by the fumes of burning sulphur, washing out afterwards with chlorine water. In spite of all precautions, however, this formidable disease has greatly reduced the silk-crop in Europe.

One investigator declares that he has detected the spores of this fungus in the eggs of *Bombyx mori* as well as in the different parts of the body of the insect, in all stages of growth.

Some of the foreign species of Cordyceps are interesting on account of their large size and branched or antlered appearance, the largest species being *C. Taylori*, found parasitic on caterpillars in New Zealand.

The vegetating process generally commences from the nape of the neck, from which it may be inferred that the insect in crawling to the place where it inhumes itself prior to its metamorphosis whilst burrowing in the soil, gets some of the spores between the scales of its neck, from which in its sickening state it is unable to free itself. These being nourished by the warmth and moisture of the insect's body, then lying in a motionless state, vegetate. The fungus then pushes its way up through the soil and appears above the surface of the ground, attaining the height of some two or three inches, sometimes branching out in antler form, or sometimes merely club-headed like a bulrush. The fungus has a strong animal smell, but the flavour is said to be like that of a nut, and is used as an article of diet by the natives of New Zealand and also by the Chinese for stuffing turkeys.

The older writers wrote very quaintly on the subject of these fungi. The Rev. W. Taylor wrote: "There are birds which dispossess others of their nests, and marine animals which take up their abode in deserted shells; but this plant surpasses all in killing, and taking possession, and making the body of the insect the foundation from whence it rears its stem, and the source from which it derives its support."

Attwood, in his history of Dominica, speaking of what he calls a vegetable fly, says, "It is of the appearance and size of a small cockchafer, and buries itself in the ground, where it dies; and from its body springs up a small plant, which resembles a young coffee tree, only that its leaves are smaller. It is often overlooked from the supposition people have that it is none other than a coffee-plant; but on examining it properly, the difference is easily distinguished—the head, body, and feet of the insect appearing at the root as perfect as when alive." The Rev. Nicholas Collins described a certain zoophyton in the Ohio county, which he declared was both vegetable and animal, for having crawled about the woods in its animal state till it grew weary of that mode of existence, it fixed itself in the ground and became a stately plant, with a stem issuing out of its mouth.

Another writer, moralising on the subject of the vegetating wasp of the West Indies, says it is an instance of a retrograde step in nature when the insect, instead of rising to the higher order and soaring to the skies, sinks into a plant and remains attached to the soil, in which it has buried itself.

Modern research has cleared up many of the doubts and difficulties of the older writers, and has brought strongly into notice the parasitic character of the fungus, which is the cause of the whole matter. There remains much to be done in unravelling the life-history of these fungi parasitic on insects; but it is to be hoped that this paper, although only a gleaning of the subject from various sources, may be of some service in furthering knowledge amongst general readers who may not have devoted any special attention to mycology.

EXPLANATION OF PLATES VI., VII., & VIII.

Plate VI.

Fig. 1.—Ripe specimen of *Laboulbenieæ.* *a*, Black organ of attachment; *b*, stalk; *c*, Perithecium; *d*, Appendage; *e*, Asci.

,, 2.—Isolated ascus, with ripe spores.

,, 3.—Two double spores fastened to wing of house-fly.

,, 4.—*Entomophthoreæ.* Diagram to explain discharge of spore in Empusa:—*a*, Enlarged spore-bearing cell, or basidium; *b*, Spore; *c*, Annular suture.

,, 5.—Mycelium ramifying in tissue of host, and sending spore-bearing tube into the outer air.

,, 6.—Conjugation of mycelium and formation of zygospore.

,, 7.—*Cordyceps.* Club-shaped head of perfect fungus, showing perithecia.

,, 8.—Portion of same, enlarged, showing escape of asci.

,, 9.—Asci greatly enlarged, showing escape of filiform spores.

,, 10.—Filiform spores, enlarged 1,000 diameters.

,, 11.—*a*, Germinating spores of *Cordyceps;* *b*, Extremities of hyphæ which have penetrated skin of caterpillar and are producing cylindrical gonidia, one of which is fixed in a blood-cell; *c*, Branches of spores which have grown out from the skin of a caterpillar killed by the fungus and converted into a sclerotium.

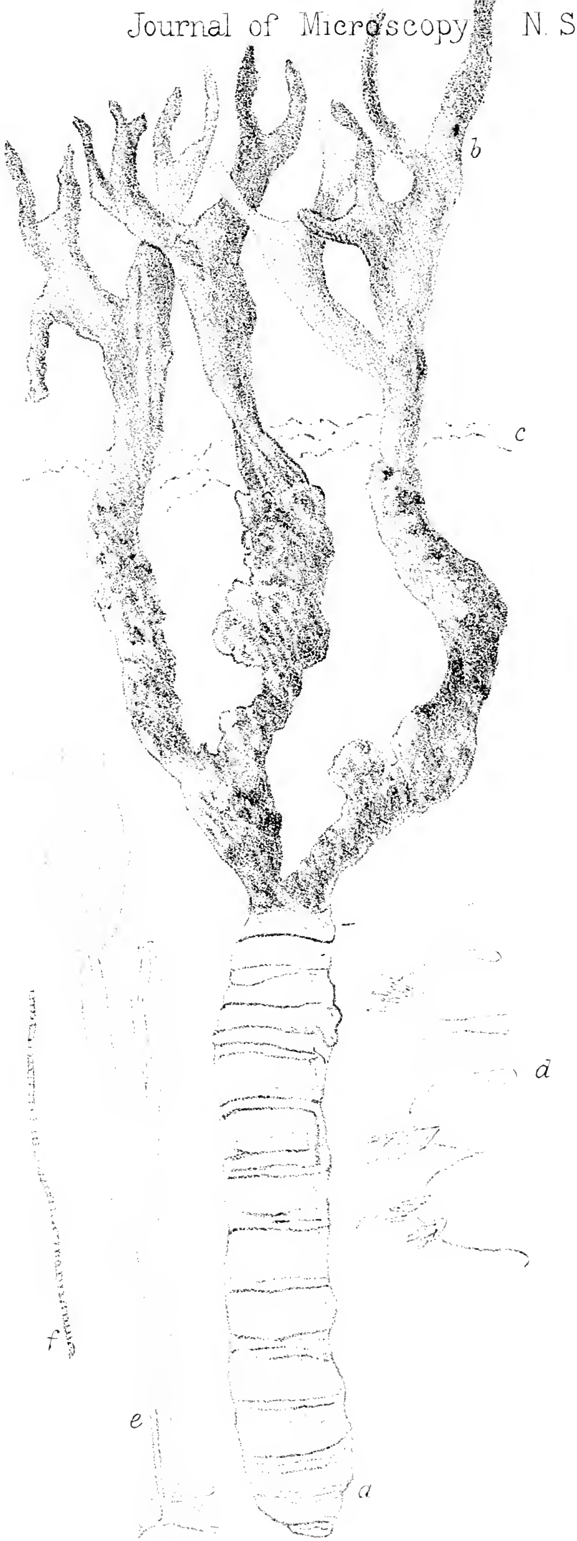
Plate VII.

Cordyceps Taylori:—*a*, Caterpillar; *b*, Fungus growth; *c*, Ground-line; *d*, Perithecia; *e*, Asci; *f.*, Spores.

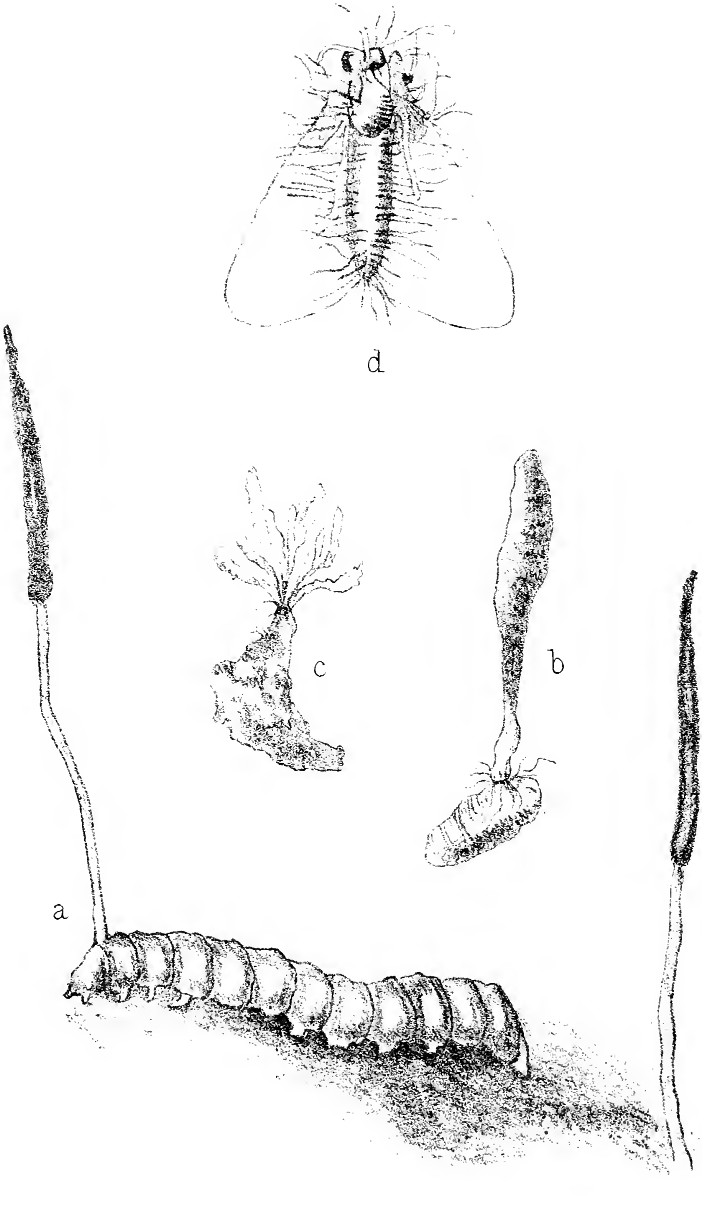
Plate VIII.

Cordyceps and *Isaria:*—*a*, New Zealand Caterpillar; *b*, Moth; *c*, Cordyceps; *d.*, Isaria.

Laboulbonieæ. Entomophthoreæ. Cordyceps.



Cordyceps Taylori.



Cordyceps and Isaria

Dips into my Aquarium.

By the Rev. William Spiers, M.A., F.G.S., F.R.M.S.

Part II.

HERE is an object which for some time has invited our attention. It seems to be a very frisky and restless creature. Its antics are as fantastic as those of the flea (see Figs. 3, 4). It is not a flea, however, as can soon be seen by looking

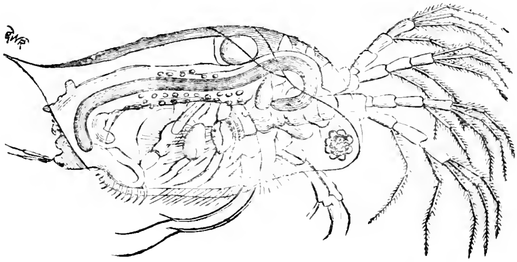


Fig. 3.—*Daphnia pulex*. Male, magnified.

at both objects under the lens. The flea is an insect in the scientific sense, and has rudimentary wings. It breathes the air like other insects properly so called. But if you closely observe this frolicsome denizen of the water, you will see that it is wholly

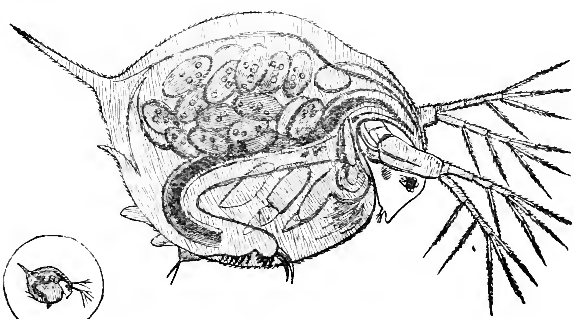


Fig. 4.—*Daphnia pulex*. Female, natural size and magnified.

different in every respect from the obnoxious *Pulex irritans*. It is, however, called a water-flea. Of these there are many different kinds. The one we are looking at is the familiar *Daphnia*. It has appendages to the head like branched antlers. Moreover, its body is perceived to be encased in an almost transparent shell, having two valves, while its feet are prolonged into plates very much like the gill-plates of fishes, only, of course, much more diminutive.

Water-fleas belong to a group of animals which form a sub-division of Crustaceans, so that they are really humble relatives of the crab and lobster. Here is Professor Nicholson's classification of the Crustacea. Provisionally taking Cirripedia or Barnacles as a sub-class of Crustacea, he proceeds to arrange all other animals of this group in two sub-divisions:—1.—*Entomostraca*, including water-fleas—Cyclops, Daphnia, etc.—with the great extinct group of Trilobites, etc. 2.—*Malacostraca*, which are either (1) sessile-eyed, like the sand-hopper, or (2) stalk-eyed, like the lobster.

The word entomostraca really means a shelled insect; and yet water-fleas are not insects, nor have they a shell, properly speaking. But words, after all, are poor things, and perhaps this name is sufficiently accurate to convey even to the non-scientific mind what sort of a creature an Entomostracan is.

Water-fleas can boast of a very ancient ancestry, for they have been traced back at least to carboniferous times, and seem to have been as numerous in the standing pools of those vast forests which produced our coal as they are now. The covering or carapace of these lowly Crustaceans is very similar in composition to the substance called *chitine*, which constitutes the outer portions of true insects. The head of Daphnia and the animals grouped with it as *Cladocera* is not covered by the carapace or so-called shell, although in some entomostracans it is included, and the creature has but one eye—a bright, inquisitive-looking organ, and evidently quite capable of doing duty for two. It is, in fact, a cluster of eyes. In the Entomostracan world the females are in the majority, and can consequently afford to be very merciful to the numerically weaker sex.

Daphnia possesses a sort of heart, a contractile organ, whose workings can easily be seen. Generally there are five pairs of legs. There are also two pairs of antennæ, the larger pair being used as natatory limbs.

Reproduction is of two kinds. Two sorts of eggs are produced by the female :—Summer eggs, from ten to half a hundred being deposited in an open space between the valves of the carapace, where they lie till the young are ready to be hatched; and winter eggs, two only in number, which are placed in what is called the saddle, on the back of the carapace, where they remain till hatched by the returning warmth of spring.

It will be known to most of my readers that nearly all Crustaceans undergo several metamorphoses during their development. The majority of the *Cladocera* emerge from the egg in a matured form; but Sars, of Christiana, has made the interesting discovery that in winter the larva leaves the egg in the form of a nauplius in the case of *Leptodora*, one of the primitive members of this group. It would be worth the while of any enthusiastic microscopist to study the development of such forms as Daphnia, for no doubt there is something more to be learned even concerning this much-observed creature.

We will now take from our gatherings a tiny bit of the pond-weed, of which there is a considerable quantity lying in a tangled mass towards the bottom of the aquarium, or waving in delicate filaments towards the surface. It must be a very small fragment, or we shall probably see nothing properly. Having placed it in a small zoophyte-trough or live-cage, we had better examine it first with an inch objective. Here is something worth a good long look. It is a tiny, transparent object, which seems to be moored to a twig, and surmounted by a couple of wheel-like organs, which appear to be constantly revolving. It is at once pronounced to be a Rotifer, or wheel-animalcule. The fact that it has two wheels makes it probable that we have come across the Common Rotifer (*R. vulgaris*), which, on closer inspection, it turns out to be (Fig. 5).

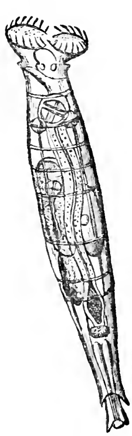


Fig. 5.—
Common Rotifer,
R. Vulgaris.

Having found it, we proceed to examine it with a rather higher power. Giving the nose-piece, on which are screwed three objectives, a slight turn, the half-inch is in position at once. A spectacle is now presented to us which, if one has never seen it before, is sure to awaken admiration and to call forth expressions of delight. Here are the wheels apparently turning round with astonishing rapidity. Just under them is a gizzard actively at work. These wheels are not really rotating, but they are made up of a circle of fine hairs called *cilia*, which lash the water in quick succession, and that begets the illusion of revolution. By the incessant play of these cilia, the water in their vicinity is kept in a state of agitation, and as a consequence multitudes of minute objects are brought within reach of the creature's mouth. Some of them are evidently rejected by the tiny epicure, for they fly away just as they seemed on the point of being swallowed, while others, more acceptable, are seen to go swiftly into the hungry maw of the animal.

A further inspection will show that the Rotifer is much more highly organised than we might at first sight have supposed would be the case with so minute an animal living under such conditions. Separate and specialised organs are soon observed. The head is quite distinguishable from the general mass of the body; the outer portion, which we will call the skin if you like, is clearly different from the internal portions; there are two small, bright spots, which are probably organs of vision; while we can also clearly perceive a small ganglion of nerve substance which fulfils the office of brain. There are also other organs inside the body, all of which have important functions to perform, especially in the reproductive processes.

The first question that a real student of these minute creatures will ask is as to their proper place in the zoological scale, and this is a point about which perfect agreement has not yet been arrived at amongst zoologists. Professor Huxley ranks them very near to the lower worms, and considers them to be "the permanent forms of echinoderm larvæ"—that is to say, they agree in many points with an imperfect sea-urchin or star-fish. Mr. Gosse, who has studied these creatures more industriously than any other microscopist, and was universally admitted to be *facile princeps* in this realm of zoology, places them still higher in the animal kingdom; and while admitting their connection with the worms, seems inclined to associate them with insects in regard to their structural affinities. The earlier arrangement of Huxley, in which they are regarded as a group of *Scolecida* or lower worms, such as inhabit water or are parasitic on other animals, is adopted by Nicholson, and is undoubtedly the safest one to follow at present.

But in whatever way the matter may be settled, these pretty creatures must certainly be exalted to a much higher position than they occupied when grouped with many other and very different organisms in that confused jumble of the earlier geologists which they called Infusoria. We have here another wonderful illustration of the rapid advance of modern biological science and a splendid testimony to the value of the microscope as a handmaid to scientific research.

Mr. Gosse prefers to call the gizzard by the name of *mastax*, and contends that it is really a mouth. He says it consists of muscular fibre. Out of it a funnel leads upwards, while a sort of œsophagus runs downwards to the stomach. Inside the mastax are two organs, which work like hammers and supply the place of teeth. They pound down the particles of food on an anvil and prepare them for digestion. All this is curious to behold, but to see these processes we need higher powers and more elaborate arrangements. Those, however, who are skilled in the use of the compressorium and can examine the rotifer with a good ⅛-inch lens will be amply repaid for their trouble.

The respiration of Rotifers is said to be carried on by means of what is termed a "water vascular system," consisting of two tubes filled with a watery fluid, from which many shorter tubes proceed into the internal parts of the body. The two large tubes run into a "contractile bladder," which pulsates like a heart, and so keeps up the circulation.

One curious fact about the Rotifers must not be omitted, and that is, the females are much more highly organised than the males. The males, however, are more free than the females, and so probably both are content.

While watching the Rotifer for any prolonged period of time, we are sure to see it, sooner or later, loosen its hold of the twig to which it was anchored, when it will swim away with cilia in action, or perhaps will tuck in its wheels and crawl in and out amongst the tangled weeds. We can now see that the tail or foot by which it held on to the plant is forked at the end and slides in and out like a telescope. Reproduction is effected by both summer eggs and winter eggs.

There are many kinds of Rotifers; but I must not overload my paper with technical names which would require for their explanation more space than I can now command. I will, therefore, finish with a brief enumeration of the groups mentioned in Professor Nicholson's Manual:—

The typical group is that of the *Notommatina* (*Hydatinea* of Ehrenberg). These are all permanently free and never occur in colonies. The integument is flexible and there is no tube.

Stephanoceros (the garlanded Rotifer) and *Floscularia* (the Flask animalcule) are fixed, and the animal has the power of secreting a gelatinous tube of a most beautiful and transparent character.

In *Polyarthra* there are fin-like appendages moved by muscles, which Mr. Gosse regarded as homologous with the articulated limbs of the *Arthropoda*.

In *Asplanchnia* there is no intestine, the "stomach hanging like a globe in the centre of the body-cavity."

The genus *Echinoderes* has no limbs and the body is imperfectly segmented; but there is a kind of proboscis, which can be protruded. It is this genus more than any other that reveals the affinity between Rotifers, regarded as a group of *Scolecida* or lower worms, with the higher worms or *Annelida*.

Huxley's *Annuloida* included *Scolecida* and *Echinodermata*, while his *Annulosa* embraced the *Vermes*, and also *Crustacea*, *Insecta*, etc; but it must not be supposed that there is anything worm-like about the appearance of Rotifers. Their affinity with the *Scolecida* proper (water worms and parasitic worms) is based on minute and embryological characters, into which we must not enter now.

(*To be continued.*)

On Certain Phenomena of Hypnotism.

By Mrs. Alice Bodington.

THE study of the phenomena, collectively known as hypnotism, is passing through the usual stages which attend the establishment of a science. It has passed through the first or empirical stage—a stage so degraded by charlatanism that its original names have been discarded by scientific workers. Mesmerism, odic force, clairvoyance, and spiritualism have been relegated to the same limbo as astrology and alchemy. All this stumbling along false paths has had its use; the constant search leads at last to the high-road. Alchemy led the way to the experiments which formed the foundations of modern chemistry, and mesmerism directed attention to a class of natural phenomena governed by laws of which we are daily obtaining clearer knowledge.

In the scientific experiments now being carried out on so vast a scale by Dr. Charcot and his assistants at the Salpêtrière, three facts stand out more prominently than others. One is that the quickest and most efficacious mode of breaking off all connection between the highest and all other centres of the brain is by means of fatiguing the sense of vision, by causing the subject to gaze fixedly at a bright light. Another is the curious effect of an unseen magnet upon a hypnotised person. The third is the extraordinary influence of mere suggestion.

It is not undesignedly that I speak of the influence of an UNSEEN magnet, since, if the subject had any idea that a magnet was being used, or of what effects it was intended to produce, the experiments would be vitiated. Hysterical patients will see and feel anything they think they are intended to see or feel. Pieces of metal applied to patients appeared to have curative effects of a marvellous character, till it was found that pieces of wood had precisely the same effect.

It may be as well, before giving a brief account of some of the most curious of Charcot's experiments, to go back to the empirical days of our science. In its early days, as might be expected, the direct agency of the gods supplied the motive power. Most especially was this manifested at the temples dedicated in Greece and Italy to Æsculapius. The sick person was conveyed to the temple, and, after ablution, prayer, and sacrifice, was made to sleep on the hide of the sacrificed animal, or at the feet of the statue of the god, while sacred rites were performed. In his sleep the appropriate remedy was indicated in a dream. Moral or dietetic remedies were more often prescribed than drugs, and the record of the cure was inscribed on the columns or walls of the temple, thereby duly impressing the minds of fresh arrivals. In short, "suggestion" of a most impressive and cheering nature formed the principal method of cure. The temples of Æsculapius occupied positions remarkable for their natural loveliness; the patient found himself in fresh air, and amidst delightful surroundings; he was soothed by the knowledge of the immediate interest of the god in his case; and all his cares were charmed away by the skilled ministrations of the priests. Under such circumstances the "vis medicatrix naturæ" had ample scope.

In studying the lives of the saints of the Christian and other religions, we find directions for inducing the state of ecstasy, which essentially consisted in fatiguing the optic centres. The Christian mystic was recommended to gaze for a lengthened period on some fixed object, placed so as to cause a painful constraint in fixing the eyes upon it, either from the height at which it was placed, or from its too great nearness to the eyes. The contemplation of the crucifix above the altar would undesignedly have the first effect, and it is not surprising to find that after a prolonged period of such contemplation, the monk or nun was found in a state of rigid catalepsy, the arms extended in the form of a cross. The Buddhist monk was recommended, as the most salutary of exercises, to fix his gaze on the centre of his body, till all consciousness of outward things had passed away, and the blessedness of a temporary Nirvana was gained; and the monks of Mount Athos employed the same means of attaining a state of ecstasy.

Coming now to what we may call modern times we find that in the seventeenth century there appeared in England several persons who said they had the power of curing diseases by stroking with the hand.* Notable amongst these was an Irishman, Valentine Greatrakes, who attained great celebrity by his supposed power of curing scrofula, known popularly as "the king's evil." Many of the most noted scientific men of the day, such as Robert Boyle and R. Cudworth, witnessed and attested the cures supposed to be effected by Greatrakes, and thousands of sufferers crowded to him from all parts of the kingdom. A belief in some mysterious personal influence, possessed by certain men, has never entirely died out since the time of Greatrakes.

About the middle of the 18th century a German priest, John Joseph Gassner, acting under the persuasion that a majority of diseases arise from demoniacal influence, attempted their cure by exorcism. His influence over the nervous systems of his patients was extraordinary, and his method of cure was similar to that followed by Mesmer and others. But it was reserved for the brilliant charlatan Mesmer himself to attract the attention of both the fashionable and the learned worlds of his period to the phenomena of what he was the first to call "Animal Magnetism." It seems to me not improbable that this very term may be restored in its old and strictly scientific sense. Now we know in all sober seriousness that animal bodies are electrical machines, and that the vertebrate heart is a living magnet.†

So little, however, was as yet known of electricity and magnetism in Mesmer's time, that his "twenty-seven propositions," even when he happened to be right, could only be of the nature of guess-work. Mesmer undoubtedly believed that the phenomena he produced were real, and were worthy of further investigation, but in his greed for money, and the sensational means to which he resorted to obtain it, he sank irredeemably into the charlatan. He had his "consulting apartments dimly lighted and hung with mirrors; strains of soft music occasionally broke the profound silence; odours were wafted through the room; and the patients sat round the 'baquet'—a kind of vat, in which various chemical ingredients were concocted. Holding each other's hands, and joined by cords passed round their bodies, the patients sat in expectancy, and then Mesmer, clothed in the dress of a magician,

* *Encyclopædia Britannica.*

† See *Journal of Microscopy*, for October, 1889.

glided amongst them," accompanied by associates expressly chosen for their youth and good looks; "he affected this one by a touch, another by a look, and a third by making 'passes' with his hand." Some patients experienced nothing; others were slightly affected; others again were thrown into violent convulsions, during which they shrieked and laughed immoderately, and showed every symptom of hysteria. They "were all so submissive to the will of the magnetiser that even when they appeared to be in a stupor, his voice, a glance, or a sign would rouse them from it."* So much excitement was caused by these marvels that the government appointed a commission, taken from members of the Faculty of Medicine and the Academy of Sciences, to enquire what truth there might be in Mesmer's pretensions. The commission, which included Bailly, the celebrated astronomer, Franklin, and Lavoisier, carried on their investigations with scrupulous care, with the result that in their report they declare "that the 'animal magnetic fluid' is not perceptible by any of the senses; that it has no action; . . . that imagination, apart from magnetism, produces convulsions, and that magnetism, without imagination, produces nothing. They have come to the unanimous conclusion that this (magnetic) fluid, since it is non-existent, has no beneficial effect, and that the violent effects observed in patients are due to contact, to the excitement of the imagination, and to mechanical imitation." From this crushing verdict there was but one dissentient vote, that of Laurent de Jussieu. With scientific courage de Jussieu published a separate report, containing his convictions on the subject. He had, himself, performed experiments, which could not, he thought, be explained by the imagination. These facts demonstrated, in his opinion, that man produces a sensible action on his fellow man by friction, by contact, and more rarely by simple proximity. This action was ascribed to a UNIVERSAL FLUID NOT YET DEMONSTRATED, which he elsewhere terms "animalised electric fluid." In short, the idea that Mesmer is on the track of a fruitful truth pervades this report. The intuitions of genius in this instance, as in so many others, proved prophetic; the rays of the coming truth were seen gilding the mountain-tops

* Louis Figuier, "Histoire du Merveilleux." Animal Magnetism. International Scientific Series.

before daylight had shone for the dwellers in the valleys of prosaic fact.

The question of animal magnetism was not, however, to be set at rest by the report of any set of men, however learned or distinguished. It passed through a period of wild charlatanism, which attained its climax in the table-turning and spirit-rapping of some thirty years since. The majority of sensible people disbelieved in the whole thing, quietly following, as the majority of sensible people do, the prevailing orthodox opinions on that and all other matters. A few scientific men, from time to time, had the courage to endeavour to sift what truth there might be in the mesmerism clairvoyance, and other marvels of the charlatans.

A fresh commission was appointed by the Academy of Medicine, in 1826. Husson, one of the members, after five years of patient research, presented a report, in which the existence of animal magnetism was affirmed:—"The results are negative or insufficient in the majority of cases." The report declares "in others they are produced by weariness, monotony, or the imagination." (The effects of weariness of the sensory organs in producing exhaustion of the highest brain centres were not then dreamed of.) "It appears, however, that some results depend solely on magnetism, and cannot be produced without it. These are physiological phenomena, and well established therapeutically." An account of the various phenomena, agreeing in most particulars with those of what we now call hypnotism, is given; the difference being that whereas certain phenomena of hypnotism appear to depend upon laws still unknown or imperfectly known, *in no case are they at variance with known laws of nature.*

Now some of the experiments reported by M. Husson are at variance with well-known laws, and verge on the miraculous; the subjects can read and can distinguish the colours and suits of cards when asleep, and with their eyelids covered; can tell the nature of other people's diseases, indicating the method of treatment, and can prophesy the date of their own epileptic attacks. It is amusing to see that the method of treatment thus miraculously indicated was in perfect accord with the appalling theories of the period as to bleeding; the somnambulist declared that the patient must be "bled several times" as a remedy for intestinal obstruction. This report, which gave so much satisfaction to the magnetisers that the Academy did not venture to publish it, sent everyone off the right track for a considerable time. Instead of seeking to discover if any of the phenomena of somnambulism could be explained by natural laws, known or unknown, the opponents of the struggling science demanded that the results of any given experiment should transcend the limits of the possible, and refused to believe without the working of miracles. The commissioners erred in a similar matter; they "directed their attention to those experiments most open to dispute, such as the transposition of the senses, the power of reading with bandaged eyes or vision, by means of the internal organs, the epigastrium, and the top of the head, together with the diagnosis of diseases, and an acquaintance with their remedies."

About this time, Pigeaire, a Montpellier doctor, claimed that his daughter could read, having her eyes covered with a bandage of black silk. M. Burdin, a member of the Academy, had offered a prize of 3,000 francs to any somnambulist who could read without using his eyes. The Academicians were not satisfied with the bandage, which they justly considered could not be adjusted so that a clever trickster would be really blinded. They suggested instead an apparatus of black silk, which was to be held at the distance of six inches from the girl's face. Pigeaire objected to this arrangement, and the Burdin prize was not awarded. A fresh magnetiser, Teste, boasted the possession of a somnambulist who could read writing enclosed in a box. But, under the lynx eyes of the commissioners, the gifted medium failed to read a word of the writing. Having thus duly ascertained that somnambulists could not perform miracles, it was proposed that the Academy should henceforth not pay any attention to the question of animal magnetism, which was to be treated for the future as the Academy of Sciences treats propositions which refer to perpetual motion or to the squaring of the circle. At this darkest hour before the dawn an event of happy augury occurred; the iniquitous practices of the magnetisers were severely condemned by the Inquisition, as applying "physical means to things in reality supernatural . . . a heretical practice worthy of condemnation." The Holy Office has seldom sounded the note of alarm, unless some dangerous truth was on the point of discovery, and damaging indeed to superstition have been the truths which have come to light through scientific researches into the various phenomena of hysteria, catalepsy, and somnambulism.

In the very year, 1841,* when the Holy See had declared that "magnetism . . . is not permitted," Dr. James Braid, of Manchester, began that series of experiments which were to rescue the study of animal magnetism from the quagmire of charlatanism into which it was sinking, and direct it into its proper channels—those of observation and experiment. Beginning as a sceptic, he was anxious to discover by what means Lafontaine, the Swiss magnetiser, was able to dupe his audience. He was soon satisfied, however, that the phenomena, however strange, were quite genuine, and he gives the following account of the way in which he arrived at this discovery. His attention was struck by the fact that one of the subjects who was "magnetised" could not open his eyes. He believed this incapacity to be genuine, and he endeavoured to discover its physical cause. It occurred to him that this cause might be found in the fixed gaze which exhausted and paralysed the nervous centres of the eyes. His first experiments were carried on in his own home, where he hypnotised his friend, Walker, by causing him to look fixedly at a wine bottle placed at such a height above his eyes as to fatigue them; and, his wife, by making her fix her eyes on the ornaments on a sugar-basin placed at about the same angle. It was evident that there was nothing mysterious about the sleep; it was only necessary for the subject to concentrate his attention on a given object till the optic centres were fatigued.

Another important discovery made by Braid related to the effect produced by a given attitude on the subject's sentiments. When placed in an attitude of anger, with clenched fists, his countenance assumed a menacing appearance, and he began to box; if he were made to imitate the action of sending a kiss, his mouth smiled. And the movements peculiar to climbing and swimming were produced when the body was placed in appropriate

* The condemnation by the Holy Inquisition took place in 1856.

positions. Braid also observed that the sleep was not always the same, but varied from a light slumber up to a profound sleep; that the senses, especially those of touch, smell, and hearing, might suddenly become excessively acute; and finally, that verbal suggestions might produce hallucinations, emotions, paralysis, etc., which might continue into the waking stage. Instead of seeking for the supernatural, Braid made it his object to account for the phenomena of hypnotism by natural laws, and, once started on a rational basis, the study progressed, and became disentangled from the mystic and miraculous theories which had done it so much injury.

During the last few years, whilst the mesmerism and spiritualism of the charlatans have been gradually sinking into well-deserved contempt, the brilliant researches of Heidenhain and Gürtzner, of Voisin, Ruher, Berger, and a host of other scientific observers, the innumerable experiments carried on by Charcot and his assistants at the Salpêtrière, and the recent discoveries of physiologists as to the localisation of function in the brain, have made of hypnotism one of the most interesting and most progressive of the biological sciences.

For a detailed account of the experiments at La Salpêtrière I refer my readers to the work on "Animal Magnetism," by Binet and Fére, on which I have already so largely drawn. I will only mention some experiments which can be parallelled in ordinary experience; and, on the other hand, one or two of the experiments which are as yet inexplicable.

The hypnotised subject "shows by the expression of her face, her words, and actions* that she believes everything suggested to her by the experimenter." One highly respectable lady imagined that she was by turns a peasant, an opera dancer, and finally the Archbishop of Paris. Another subject, who had been asleep for only a few minutes, imagined that several hours had elapsed. The illusion was encouraged by telling the patient it was two o'clock, whereas it was in reality only nine in the morning. When she heard this she felt extremely hungry, and begged to be supplied

* Charcot's experiments being carried on upon female patients, the feminine pronoun is usually employed.

with food. This imaginary hunger was satisfied by an equally imaginary meal. The patient was told there was a plate of cakes on a corner of the table, of which she might partake, and in five minutes her hunger was appeased.

I was acquainted with a girl who was, at the time I knew her, apparently in excellent health. I discovered accidently that V. S. showed signs of acting anything I chose to tell her whilst she was asleep. If I told her she was going out for a walk she would go through all the motions of putting on a bonnet, buttoning a jacket, drawing on boots, etc., and would get out of bed and walk across the floor. If I told her she was ill, she groaned and sighed; if I told her of pleasant things, her countenance showed every sign of joy. I was deeply disconcerted on one occasion, when, having told V. S. she was thirsty, she asked for, and I gave her a glass of water, which she lifted to her lips, and, in attempting to drink, spilled the whole contents of the tumbler over her dress. My experiments for that night ended by a good scolding, of which I became the "subject." This girl in after years became markedly neurotic, and would, no doubt, have responded readily to every species of suggestion. I had never heard of mesmerism at that time, and only recalled these girlish experiences upon reading of the Salpêtrière experiments.

A very curious instance of the effect of suggestion was the experiment tried by Focachon, a chemist, at Charmes, on a hypnotised subject. Focachon applied some postage-stamps to the patient's left shoulder, kept them in place with some strips of plaster and a compress, and suggested that he had applied a blister. The man was watched, and when twenty hours had elapsed the dressing, which had remained untouched, was removed. The epidermis beneath was thickened, dead, and of a yellowish white hue, and this region of the skin was puffy and surrounded by an intensely red zone. Several physicians confirmed this observation, of whom one, named Beaunis, made photographs of the blister, which he presented to the Society of Physiological Psychology, June 29th, 1885.

Bourru and Burot, professors at Rochefort, published records which throw light upon the so-called "stigmata," or areas which undoubtedly bleed periodically in neurotic subjects, such as Louise

Lateau. One of these professors suggested to a hypnotised subject, upon whose arm he had traced letters with the blunted end of a probe, that he would go to sleep that afternoon, and blood would issue from his arms on the lines that had been traced. The subject fell asleep at the hour named; the letters then appeared on the left arm, marked in relief, and of a bright red colour, which contrasted with the general paleness of the skin, and there were minute drops of blood in several places.

Strange as these cases appear, they may be parallelled by the singular effect of mental impressions upon the body in perfectly healthy and wideawake people. Dr. Carpenter relates the case of a lady who saw a heavy gate about to swing-to upon the ankle of a child, in whom she was particularly interested. "It was impossible," she said, "by word or act to help him, and, in fact, I could not move, for such intense pain came on in my ankle, corresponding to the one which I thought the boy would have injured, that I could only put my hand on it to lessen its extreme painfulness. When my stocking was removed I found a *circle round the ankle, as if it had been painted with red currant juice*, with a large spot of the same on the outer part. By morning the whole foot was inflamed, and I was a prisoner to my bed many days." *

In the *B. Medical Journal*, a case was reported of a gentleman who was convinced that he had swallowed his false teeth. His medical attendant found him apparently almost in the agonies of death, and suffering from every symptom which usually attends the impaction of the springs of false teeth in the throat. Fortunately, before the patient had quite frightened himself to death, the teeth were found innocently wedged behind a chest of drawers, and the alarming symptoms disappeared as if by magic.

Another effect of suggestion is the inability of the subject to see a real person or thing, which she has been assured when asleep that she will not see when she wakes. For instance, one of M. Charcot's patients was told—"On awaking you will be unable to see, or hear, or in any way perceive M. X——, who is now present; he will have completely disappeared." When the subject awoke she saw all the persons round her except M. X——.

* Dr. Tuke, quoted by Dr. Carpenter, "Mental Physiology," p. 682.

When he spoke she did not answer his questions; when he laid his hand on her shoulder she was unconscious of the contact; and when he stood in her way she walked on and was alarmed to encounter an invisible object. On another occasion a patient was terrified when a gentleman, who had been rendered invisible by suggestion, took off his hat. She saw a hat describing circles in the air, without anything apparent to set it in motion. M. M. Binet and Ferè say they are utterly unable to account for these phenomena. Yet, is there anything in the above facts differing greatly from what occurs in everyday life, especially to those among us who possess the rather doubtful gift of abstraction? Are we not every day of our lives utterly deaf and blind to loud sounds and conspicuous objects, either from habit, from not expecting to see or hear anything, or from pre-occupation with some train of thought which makes the highest centres of the brain utterly oblivious of everything passing outside? If we think some object we require is in the next room, we probably go to fetch it, even if it is lying exactly in front of our noses; if an express train goes by, or a cannon is fired within a few yards of us, we notice neither the one nor the other if we are accustomed to the sound; and many of us can read and write in the midst of all the noise a young and healthy family is capable of making. There seems nothing particularly wonderful in the fact that a highly sensitive subject should not see some object in front of her eyes if she is told she will not see it.

Dr. Carpenter tells many odd incidents with regard to the absence of mind of Dr. R. Hamilton, a distinguished professor at Aberdeen. He would give lectures, with a white stocking of his wife's on one leg and a black stocking of his own on the other; he did not recognise his wife if he met her in the street, and would apologise for not having the pleasure of her acquaintance; and if he ran against a cow in the road he would beg her pardon, call her "Madam," and hope she was not hurt.

Amongst the curious facts attending suggestion which I hope to show are also not unparallelled in ordinary life, is the obedience of subjects to commands directing them to do or to feel something at a given hour and at some distant date; and the utter want of recollection on the part of the subject that he is not acting of his own free will. I will give one instance. M. Bernheim said to S——, formerly a sergeant, whilst he was in a state of somnambulism, "On what day will you be free during the first week of October?" The ex-sergeant replied, "On Wednesday." "Then listen to me. Go to Dr. Liébault on the first Wednesday in October, and you will see the President of the Republic, who will give you a medal and a pension." He said that he would go, but remembered nothing of it when he awoke. On the 3rd of October, however, sixty-three days after the suggestion, S. presented himself at Dr. Liébault's. Without paying attention to anyone he went to the left side of the room, made a respectful salute, and said, "Your Excellency." Then he extended his right hand, as if receiving something, and said, "I thank your Excellency." Dr. Liébault then asked him to whom he was speaking, and he replied, "To the President of the Republic."

That curious and most mysterious process which we call unconscious cerebration may enable persons who have been hypnotised to perform certain actions at a given date, without recollection in the interim, just as anyone in ordinary life may forget a name, or a fact, or a date, and find it suddenly "come back" to the memory without conscious effort. So, too, we constantly remember with extreme suddenness some action to be performed at the time we recollect it, though we have forgotten all about it in the meantime. Many of us wake from deep sleep at a particular time every morning, and there must be a *something* keeping guard, a habit impressed on some brain-cell. A child falls out of bed, until some process of unconscious cerebration is established which prevents us from falling out of bed in the deepest or in the most uneasy sleep.

The phenomena, which I venture to think are the least explainable by any laws known at present to us, are some of those attending hallucinations of vision, and the "transposition of the senses" caused by the action of a magnet.

If, by means of suggestion, a portrait is caused to appear on a sheet of cardboard, of which both sides are alike, the picture will always be seen on the same side of the cardboard, and, in whatever direction it may be presented, the subject will always place it in the position which it occupied at the moment of suggestion, so that it may not be inverted nor even inclined. If the cardboard is turned round the portrait is no longer seen; if it is turned upside down the portrait is seen with its head downwards. The subject never makes a mistake. If his eyes are covered, or if the experimenter stands behind him while changing the position of the object, his answers are always in conformity with its original localisation. If the card be mixed with a dozen other precisely similar cards, he sees it at once. But what is still more extraordinary is that this hallucinatory vision is modified in precisely the same way as ordinary vision. An opera-glass brings imaginary objects nearer, or makes them appear further off, according to the end of the glass presented to the eye, precisely as if the objects were real. Moreover, the opera-glass will not make objects appear more or less remote unless it has been adapted to the subject's sight. W——, who is short sighted, could see nothing through a glass adapted to C——'s long sight. If a prism is used the imaginary object appears doubled, the images appearing to be one below the other, or side by side, according to the position of the prism. Precautions are, of course, taken that the subjects should not be aware that they are looking through glasses or prisms. We have here phenomena resulting from some action of the visual centres which we do not understand, but we have nothing which conflicts with known laws. A subject cannot see through a *real* person who has been made invisible by suggestion. She imagines that she can, but she cannot describe correctly what is going on behind where the real person is obscuring the field of vision. In the same manner a subject may be made to imagine himself the victim of various accidents and diseases, but he cannot describe correctly the symptoms of any disease he has not really had. Also, on looking through an imaginary microscope, the image on a slide (of a spider's leg, for instance) will appear enormously large, *but no object will be perceived that is invisible to the naked eye.* The diameter of the pupil varies with the assumed distance of the imaginary object. M. Ferè says, "When we desired two of our patients to look at a bird perched on a steeple, or flying high in the air, the pupil was gradually dilated until its normal diameter was nearly doubled. When we caused the bird to fly down, the pupil gradually contracted, and the same phenomenon was reproduced as often as the idea of any moving object was evoked." In short, hallucinatory vision follows in every respect the laws governing ordinary vision.

The other phenomena, which are as yet inexplicable by any laws known to us, are those of the transference of sensation, the obliteration of real images, the transfers of impulses and of resolutions, caused by an unseen magnet placed near the subject. A paralysis of the right side will be thus transferred to the left; an action which a hypnotised patient is ordered to perform with the right hand can only be performed with the left; an impulse to murder is changed into a display of violent affection. A patient ordered to count up to a hundred became gradually unable to articulate the numbers, after the application of a magnet, although her lips continued to move.

Another patient was so violently affected by the sound of a Chinese gong that the fear of hearing it was sufficient to send her into a fit of catalepsy, if she only saw the instrument. In this condition she was awakened and requested to look attentively at the gong, and meanwhile a small magnet was brought close to her head. After the lapse of a minute she declared she could not see the instrument, and that it had completely disappeared, and when the gong was sounded loudly she only looked about her with an air of surprise.

Reasoning is by no means invariably absent during the hypnotic state, but is of as unsteady a nature as reasoning in dreams. The patients, perhaps, see the folly or the wickedness of certain acts they are required to perform, but always end by doing as they are ordered. They also reason as to the mode in which certain simple suggestions are to be carried out. It was suggested to a subject that she should poison X—— with a glass of pure water, said to contain poison. She offered the glass to X——, and invited him to drink by saying, "Is it not a hot day?" It was in summer. Many subjects display their honesty by refusing to commit a theft. They may reply, "No, I will not steal, I am no thief." Z—— was armed with a paper-knife, and ordered to kill Y——. She said, "Why should I do it? He has done me no harm." The experimenter still insisting, her scruples were overcome, and she soon says, "If it must be done, I will do it." On awaking she looked at Y—— with a perfidious smile, looked about her, and suddenly struck him with the supposed dagger. How often in real life have crimes been committed at the suggestion of a strong-minded person controlling a weaker one, precisely as the poor hypnotised patient of La Salpêtrière was driven to commit her imaginary murder!

One exception to this rule of obedience is mentioned, and one only. A young girl, still deeply attached to a young man who had cruelly used her, resisted every suggestion that she should do her lover an injury; she showed signs of the greatest distress, and tried to escape, yet she remained inflexible. On every other point her obedience was automatic.

The actions of a frog or fish, deprived of its cerebral lobes, resemble the automatic actions of a hypnotised person. I need hardly say that the frog or fish, if untouched, remains perfectly quiescent, and would remain so till it died. But the frog, if thrown into the water, will continue to swim till it is exhausted; if it is placed on the palm of the hand, and the hand is gently turned, it will adjust its movements with the utmost nicety till it finally rests on the back of the hand. In the same manner a pigeon similarly treated, will fly when thrown in the air, and will continue to fly, and will eat and drink when food and drink are presented to it. A subject to whom soap is given will go on washing his hands indefinitely, and on one occasion, says Regnard, the operation was protracted for two hours. If a woman is putting on her boot she will go on doing up and undoing the laces for an indefinite period, and if a piece of crochet work is given her she will make a long chain of loop-stitch without attaching it to the rest of the work. In short, the action goes on as long as contact with the object which suggested the action is continued.

I have, myself, often noticed the automatic way in which occupations are carried on by patients suffering from melancholia or dementia. If work were put in their arms they would go on working in a machine-like manner for hours, sometimes executing some beautiful piece of embroidery, yet not capable of drawing the work to them if it was at a little distance, and if a thimble dropped, not attempting to pick it up again.

Similarly, a patient seated at a piano, and music placed before her, would go on playing for hours from the same lines without turning over a page. All the complicated co-ordinated movements involved in the acts of sewing, and of playing from printed music, which require the action of the higher centres of the brain in their acquisition, have become by habit as purely reflex as are the complex co-ordinated movements of the frog as he balances himself from the palm to the back of the hand. My space is now drawing to an end, and I regret that there has been only room for a very small part of the interesting facts which could be related on the subject of this article.

One is driven at last to wonder what is this "Ego" of which we are more supremely conscious than we are, or can be, of anything else. Is it a collection of innumerable, separate consciousnesses controlled into one whole in health, by the highest cerebral centres; as our bodies, of which we are also supremely conscious as a whole, are composed of many billions of monads, living, dying, devouring one another, multiplying, executing their several functions, independently of any will of ours? We read of patients of bad character, and with intolerable tempers, becoming valuable members of their families, whilst kept in a continued state of suggestion; of idle students becoming industrious under similar conditions. Where is the "Ego" here? For if the subject is allowed to escape the influence of suggestion, no recollection of the better self is left. The phenomena of double life, where the patient really leads the life of two independent individuals, are as yet most imperfectly understood, though they have about them nothing miraculous. Cases, well authenticated, are known, where the patient leads not only two independent, but several lives, in each of which he has no recollection whatever of what he has done, or learned in the others. About six years ago such a case was reported, with the fullest details of time and place, in the *British Medical Journal;* the patient being a French peasant-lad.

We shall doubtless for many a year have cause to say with Hamlet, "There are more things in heaven and earth, Horatio, than are dreamt of in our philosophy."

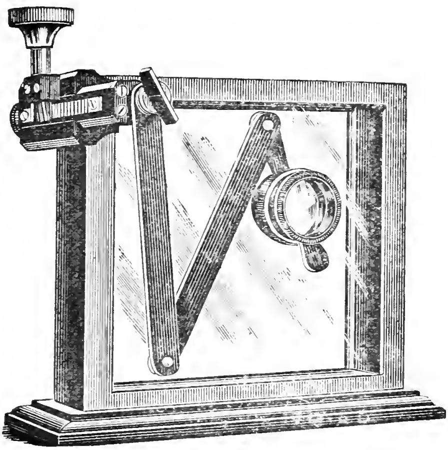
I should feel much obliged to any person reading this paper if he would kindly furnish me with the details of this case, if he has the back numbers of the Journal. Address to "Care of Editor."

On a Simple Tank Microscope.*

By C. Rousselet, F.R.M.S.

I DESIRE to bring to your notice a small tank microscope designed for the purpose of rapidly looking over pond water and weeds, collected at a day's excursion, and placed in a small parallel-sided window aquarium.

The instrument hardly needs description; its working will be readily understood by reference to the figure.



One of Zeiss' aplanatic lenses is carried on a jointed arm, which moves parallel to the side of the tank, and the lens is focussed by means of a rack and pinion, the whole being fixed to the upper left-hand corner of the tank by means of a screw clamp.

The following points will recommend themselves to those who are in the habit of looking at their captures with the pocket lens in the ordinary way :—

When an object of interest is found, it can be followed with the greatest ease and taken up with a pipette, both hands being free for this operation.

* From "The Journal of the Quekett Microscopical Society."

It so frequently happens that a minute object is lost, simply by removing the pocket lens for an instant to take up the pipette ; in the above apparatus the lens remains in the position in which it has been placed.

The definition of these aplanatic lenses is excellent: the lowest power has enough working distance to focus through all my tanks, and the magnification (6 diam.) is sufficient to permit of the identification of all ordinary rotifers, and anything uncommon, or new, is at once recognised. Such delicate creatures as the *Floscules*, which are all but invisible with the ordinary pocket lens, are seen without difficulty, and the whole contents of the tank can be ascertained with a great saving of time.

I would also specially recommend these small window aquaria to those not already acquainted with them, as affording the very best means of examining pond water for microscopic life.

The Pine Destroyer (*Hylurgus piniperda*).

By the Rev. Hilderic Friend, F.L.S., Carlisle.

Plate IX.

Introductory.

It was truly remarked by Curtis* early in the present century that "although the oak and many other trees maintain multitudes of insects, none appear to support more destructive inhabitants than the Pines." Since these words were written, many additions have been made to our knowledge of the parasites and saprophytes which infest our healthy as well as our moribund fir-trees, and with this increase of knowledge we have no warrant for modifying the conclusion formerly arrived at. These "destructive inhabitants" are not confined to either the animal or the vegetable kingdom, neither are they represented by one particular order, family, or genus of plants or insects. Within recent years much has been written about the fungoid parasites of the Pines,

* *British Entomology*, Vol. III. (1826), Plate 104.

such as *Peridermium Pini*,* *Peziza, Willkommii*, *Trametes radici, perda*, *Polyporus sulphureus*, *Trametes Pini*, and the like. Withering wrote sixty years ago of the Scotch Fir, that "It affords nourishment to Phalæna Pini, Curculio Pini, and Cimex Abietis. Aphis Pini converts the buds or young shoots of the Fir into a very beautiful gall, somewhat resembling a Fir-cone or a Pine-apple in miniature. A species of Chermes sometimes produces an enormous scaly protuberance at the summit of the branches, which is formed by the extravasation of the juices occasioned by punctures made in order to deposit their eggs—the young larvæ sheltering themselves in cells contained in the tumour. It has lately been ascertained that Fir-trees are likely to be absolutely destroyed by the perforations of Sirex juvencus, as the woods at Henham-Hall, Suffolk, testify. *Noctua pinastri* deposits larvæ in the leading buds, often perforating the young shoots, and thus depriving the tree of its leader. And here must be introduced *Achatea spreta* (*Noctua piniperda*, Kob),† a moth whose larvæ totally consume the foliage (which the green-striped caterpillar singularly resembles), occasionally ravaging even extensive forests. The magnificent and rare insect, Odonestis Pini,‡ also feeds upon the Scotch Fir, and the Pine forests of Scotland are the most productive places for the uncommon (*sic*) *Lophyrus Pini* (and also *Lophyrus pallidus*)** whose larvæ are gregarious, assembling in numerous troops on the branches and not only devouring the leaves of the Pine, but also the bark of the young shoots. The leading branches are likewise destroyed by the beetle, *Hylurgus piniperda*." It is with this latter alone that we are now concerned, but it may be of interest if I remark that Miss Ormerod, in her "Manual of Injurious Insects,"†† describes no fewer than eight different kinds of parasites which prey upon the various species of Pine—two moths, two beetles, two species of sirex, an aphis, and a saw-fly—several of which are different from those enumerated by Withering. It thus appears

* *Timber and some of its Diseases:* By Prof. H. Marshall Ward. 1889.

† Curtis, Br. Ent., III., Pl. 117.

‡ Ibid I., pl. 7.

** Ibid II., pl. 54. I have recently bred L. rufus in Carlisle.

†† Pp. 217, seq.

that the Pines alone would supply us with material whereby we might get to know the life-history of almost every typical order of insects and fungi.

Classification.

What place does the insect occupy in the *Systema Naturæ ?*

Hylurgus piniperda belongs to the order Coleoptera, a very remarkable group of insects numbering many thousands of species, and readily distinguished by the presence of elytra or hard wing-cases. The ordinal name has been borrowed from this pecularity, for the term Coleoptera comes from two Greek words—κολεός, a sheath, and πτερον, a wing—the anterior pair of wings having the form and properties of a sheath, for the purpose of covering and protecting the hinder wings and abdomen of the insect. These sheaths are not used in flight; they are often richly variegated, and never cross over each other, but lie edge to edge down the middle of the insect's back. "The posterior (or hindmost pair of) wings are membranous, presenting a ramification of veins, and usually folding up under the elytra. The mouth of the Coleoptera is provided with mandibles, with jaws, and two quite distinct lips, and is suited for mastication. They undergo omplete metamorphosis." The order is divided into numerous groups or families, depending in the first instance upon the number of joints in the tarsus or terminal portion of the leg. In some there are five joints, whence the name Pentamera; next come the Heteromera, in which section are included all those species which have five articulations in the tarsi of the fore and middle legs, and four in the hindermost pair. The third section embraces beetles the whole of whose tarsi have four joints, and these are known as Tetramera; and finally come such as have three joints, or the Trimera—a limited group, but well known by its common representative—the Lady-bird or Coccinella.

Into the subdivisions it is not necessary for me to enter; I will therefore simply state that Hylurgus belongs, according to some authors, to the group having five joints* to each tarsus, and is therefore classed among the Pentamerous beetles—which is by far the largest of the four sections.

* See Curtis, III., 104 but cf. Houghton, Br. Ins. p. 147.

There comes in at this point, however, a question of structure and arrangement which makes this tiny beetle an object of profound interest. While some systematists put it with beetles having five joints in each tarsus, others arrange it with the Tetramera or four-jointed group. How, it will be asked, can such a curious circumstance be explained? The tarsus must have either four or five joints, and it ought to be easy at once to decide the position of the insect in systematic entomology by counting the joints. Whatever *ought* to be the case, in this instance it is not easy to decide which arrangement is the more accurate, and herein lies the interest; because we find in the peculiar structure of the tarsus in Hylurgus the connecting link between the two great groups—Pentamera and Tetramera—by which the truth that nature makes no leaps is again confirmed.

The explanation of this curious phenomenon may be best understood by the study of the accompanying diagram. If we take a side view of the leg of Hylurgus (Plate X.) it is quite certain that we shall be able to detect no more than four joints to each tarsus, and under these circumstances we should be perfectly justified in placing it among the Tetramera. If, however, by careful manipulation we can get a front view of the leg, we find that the third joint is of a somewhat peculiar shape, and has developed into an abnormally large one, at the expense of the fourth, which, while it may be said to exist, is in so rudimentary a state as almost to escape detection. If its presence be admitted, however, no matter how dwarfed and rudimentary its size and form, it justifies us in placing it among the Pentamerous group. I shall not be accused of straining a point if I remark that such cases as these seem to suggest a process of development or evolution, and thus tend to throw light upon one of the most perplexing problems of the day. I must not here be tempted to allude to analogous instances in other realms of nature, but pass on to observe that there are several species of Hylurgus, of which the best-known are—

Hylurgus pilosus,	Hylurgus crematus, and
Hylurgus fraxini,	Hylurgus pilaceus (?),

about each of which Dr. Chapman wrote some very valuable papers in the "Entomologist's Monthly Magazine" of 1868—1869.

He also worked out the life-history of Hylurgus piniperda, but did not publish his observations, as he found that Perris and others had already written fully on the subject. This is much to be regretted, as the authors to whom he refers are almost unknown to the English public, although their works may be of standard value to the specialist.

Description.

We come now to the individual character of the species before us. For the sake of clearness it may be well to take first a general view of the insect, then go more fully into the microscopic details. Hylurgus piniperda is exactly three-sixteenths of an inch in length (as far as my experience and measurements go); it is of a somewhat brick-red colour when young, becoming darker with age, till having passed through a brown, it finally reaches a black,* pitchy colour. Under a pocket lens it is seen to be covered with minute punctures, which are arranged in nine rows or striæ on each of the elytra, and gives rise to lines of hairs, causing the appearance of pubescence, which every observer will at once recognise. The wing-cases or elytra are strong, a little broader than the thorax, and rounded down at the sides and posterior extremity in such a way as to fit exactly over the wings and abdomen. It is very curious to observe the way in which the insect progresses from the earliest stage to this condition of perfection. First comes the egg, which the female deposits under the bark of the fir-tree in early spring,† and from which in due time the larvæ or maggots are hatched. The larvæ are about one quarter inch in length, and have no legs. They are fleshy, and of an ochreous colour about the head and tail, and whitish over the rest of the body. The rings behind the head are larger than those of the posterior part of the body. The period during which the larvæ remain in their tunnels, as well as that occupied by the pupæ, depends largely on the season. If wet and cold, progress is slow, but if the season is hot the beetles emerge from the dead pine trees, where they have so far passed their life, and begin to fly about among the living pines in July or

* Not real, but apparent as micro-mounts show.

† Miss Ormerod's Manual, etc., pp. 217—8.

August. Here, during the warmer months, right up till October, they are busy at work; then hybernation takes place, until the warmth of returning spring once more stirs them to duty. To obtain a perfect set of materials, therefore, one needs to work carefully among the plantations from early spring till early winter. The beetles can be easily captured and submitted to examination.

The process of dissection, when the insect is newly killed, is necessarily a somewhat delicate one, owing to the horny nature of its covering, as well as to its diminutive size. A pair of the finest cambric needles thrust well up into their handles, a drop of liquid gum or glycerine to keep the disjointed parts from flying away, and a dissecting lens or microscope, are the appliances needed. Turning the insect on its back, the head and thorax may be severed from the abdomen, the sheaths, wings, and legs from their respective attachments, and the individual parts examined fresh, and sketched or mounted for permanent reference, as desired.

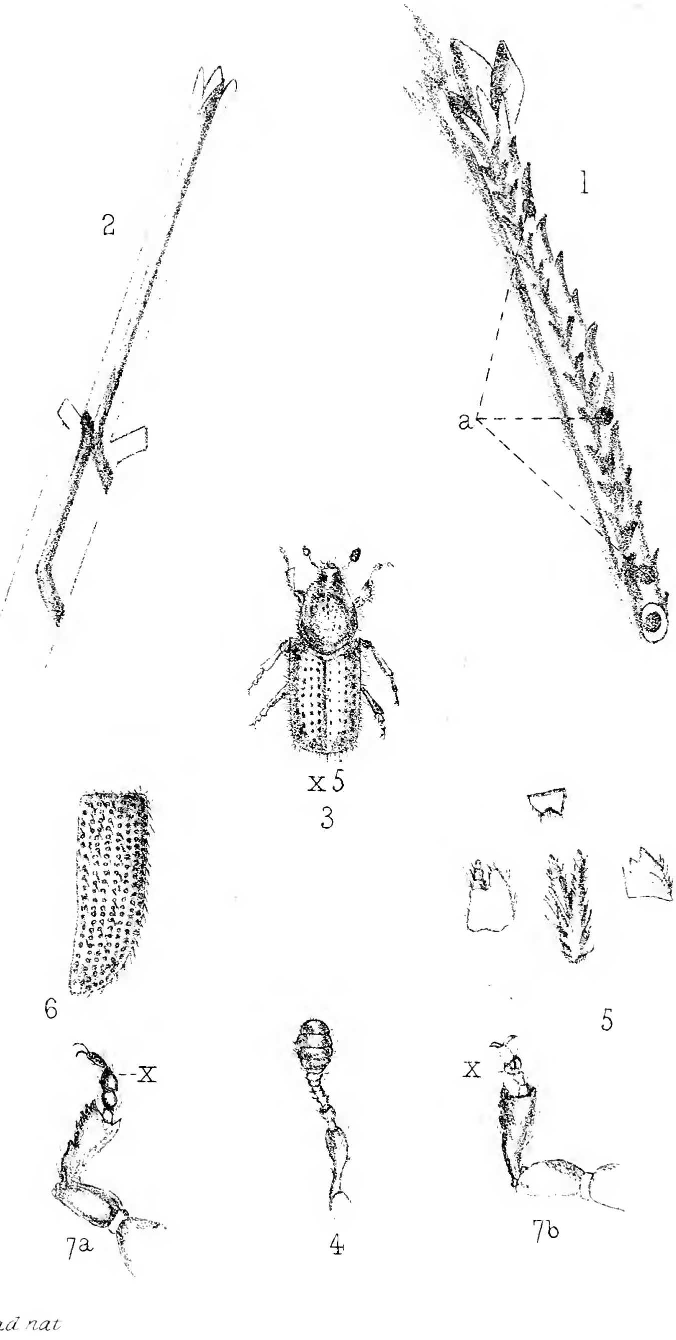
The more ready method, however, consists in steeping a few of the insects in liquor potassæ for a few days, the period being regulated by the strength of the decoction, when the process of dissection will be greatly facilitated. Having completed our dissection, we are now able to determine the character of its several parts. Beginning at the head we find it minutely punctured, with a short ridge between the antennæ. These latter organs are short, club-shaped, and hairy, composed of no fewer than eleven joints, no two of which are exactly alike. Beginning with the basal joint, or that nearest the head, we find it very long, in comparison with the others, curved, and club-shaped. The next is almost spherical, and the third cup-shaped. Then follow four joints, which gradually widen out and give support to four others, which are so arranged as to form an oval head, giving the antennæ the appearance of a delicate and chastely formed pair of clubs. Between these lie the mouth-organs, consisting of the usual parts, viz.:—(1) The small ciliated labrum, or upper lip. (2) A pair of small, but very powerful mandibles or jaws, somewhat triangular in shape with two teeth or denticulations (not differing in structure, or capable of being removed from the jaw). These are, of course, on the inner edge of each mandible, and enable the insect to eat its way through pith, cortex, or solid wood. (3) The second pair of jaws comes next. These are known as the maxillæ, and are far less formidable than their predecessors; horny, short, and blunt. Externally they are pilose or hairy, but internally they bear a number of spinous bristles. To the maxillæ (4) is attached a pair of feelers or palpi, which are known as maxillary palpi, to distinguish them from the labial palpi (5), which are attached to the labium. In each case the palpi are three-jointed, short, and somewhat blunt. The chin (6) or mentum, which forms the lower part of the mouth, is obovate, hairy, and bears a minute, ciliated lip, together with the feelers or labial palpi. Behind, and on either side of the antennæ, are the small, elongated, compound eyes. The head, though somewhat globular, is slightly produced, or sharpened down in front, and (with the exception of the under surface) the whole is covered with short hairs and minute punctures.

Following the head is the thorax, which is minutely punctured, and bears the fore pair of legs. These consist of the usual parts—coxa (hip), trochanter, femur (thigh), tibia (shank), and tarsus. The tarsus, as we have seen, is of importance in the study of beetles, as its structure forms the basis of classification.

Next comes the abdomen, which is cylindrical in shape, and bears the middle and hind legs, the sheaths or elytra, and the membranous wings. By turning the insect on its back one is able to count the segments of which the abdomen is composed. The wings, when not in use, are carefully folded under their cases, but extended beyond them when opened for flight. The elytra make the hinder portion of the insect slightly broader than the anterior portion, but the symmetry of the entire insect is well sustained. It will be seen that the wing cases have nine rows of papillæ each, from which hairs are produced; while other hairs grow irregularly between them, on both the outside and the inside. Into the structure of the nervous system, the organs of generation, and other details, it is not my purpose here to enter.

Explanation of Plate IX.

Fig. 1.—Dead twig, showing excavations (*a*).
,, 2.—Diagrammatic section.
,, 3.—*Hylurgus piniperda*, enlarged (5 diam.).
,, 4.—Antenna. } Magnified.
,, 5.—Mouth parts. }
,, 6.—Wing-shield (elytron). }
,, 7.—Leg in different positions. }



H. del ad nat

Hylurgus piniperda.

A New Staining Method.

By J. W. Gatehouse, F.I.C.

IN the last number of the Journal I perceive Kukenthal's staining method is given. Having used this, to some extent, during the preparation of sections in illustration of the papers on "Development of the Tadpole," which recently appeared in this periodical, it was found to possess two disadvantages:—Firstly, several of the colours, especially the blues, were not permanent, but were obliged to be prepared shortly before use, as otherwise the solutions became colourless, although the object when once obtained retained its colour admirably.

Secondly, owing to the exigencies of my particular work, the slides were previously coated with a solution of bleached shellac in preference to collodion, as the former could be melted at any period after their preparation, whereas collodion soon set and became useless; like the solution, each slide requires covering immediately before use.

Now, with the shellac process, the blue stains obtained by Kukenthal's method unfortunately stained the shellac ground as well as the object, thus rendering the slides unsightly.

Under these conditions the following method was found to work well. Take the filtered oil of Turpentine and saturate it with Picric acid, adding the acid gradually till a fine, yellow colour has been obtained, and scales of the acid remain undissolved. To this solution add, carefully, crystals of re-sublimed Iodine, taking care to add only a few at a time, as otherwise the chemical action set up may possibly produce sufficient heat to ignite the turpentine, and even cause a slight explosion. With all due care even a series of small decrepitations may be noticed as the Iodine dissolves. Sufficient Iodine should be added to change the colour of the solution from a light yellow to a distinct brown tint; this solution, when used on embryonic tissues, is capable of differentiating cartilage, muscle, and nerve tissues, especially the grey matter of the brain, which it turns brown, whilst remaining structures take various shades of yellow, or yellow and brown mixed, according to their composition.

By the use of this compound it is possible to stain objects, which after mounting in Balsam have become so transparent as to be scarcely visible. All that is necessary is to place the slide in a dish containing turpentine, to which some of the stain has been added, and allow it to remain there till the balsam is softened, and the stain has penetrated and done its work, when the turpentine can be readily replaced by more balsam. In this way I have stained slides of embryonic tissues which had been mounted several years, and which were almost invisible, except in special lights. After two days' soaking the whole of the structures were brought out splendidly, every detail being perfectly clear.

The Indian Chank* Shell,

Turbinella Pyrum (*Lamarck*).

By the Rev. Charles Crawshaw (of Yorkshire Naturalists' Union).

In shape and size this interesting shell may be compared to a large and symmetrically-grown pear, the long, straight canal corresponding to the stalk of the fruit. In the earlier stages of its growth a few reddish spots are scattered over the body-whorl, but in adult specimens these spots disappear, and the whole shell becomes of an ivory whiteness, and the interior is of a pale yellow or light salmon colour, and upon the central pillar are three strongly-marked denticulations.

Turbinella pyrum is found at a depth of two or three fathoms in all the Indian seas, and is particularly abundant in the waters yielding the pearl oyster. It is occasionally imported into Calcutta from the Arabian and Persian Gulfs; but the Gulf of Manaar, on the west coast of Ceylon, has furnished the market with four or five millions of shells in a single year. All these were procured by the divers with the animal attached, for the merchants will not purchase the dead shells which are sometimes cast by the surf upon the shores.

* Pronounced as if written "Shunk."

At one time the Chank fishery was a Government monopoly, producing a revenue of £4,000 a-year for licenses; but all restrictions upon the fishing are now removed, and western ideas are already affecting an industry which has existed for hundreds of years.

The Chank shell is remarkable for its solidity and heaviness, and is commonly employed by the fishermen on the Coromandel and Malabar coasts as a sinker for their nets. A fringe of these ponderous casts attached to the lower edge carries down their fishing-gear into deep water as effectually as plummets of metal. The weight and smoothness of the shell are also utilised in the process of glazing cotton goods and in polishing the surface of paper. The principal use of the chank shell, however, is in the manufacture of bracelets, bangles, and other personal ornaments. The Indian women wear these decorations profusely. From five to twenty bangles may be seen upon each wrist, and as many more upon each ankle, and as they are not removed at death there is a large and constant demand for them. This native jewellery is so coveted by the Indian belle that her trinkets are called "her joys," and so indispensable to her adornment that husbands and fathers annually expend large sums of money in the purchase of them.

In the manufacture of bangles the shell is cut into rings by means of a rude semi-circular saw, worked by the native artificer with his hands and his feet, the inside of the rings being enamelled to cover the roughness left by the saw. The outer surfaces of the rings are skilfully painted with devices in red or blue, or covered with gold or silver tinsel, and studded with coloured beads or valuable gems.

The larger bracelets are formed of many segments and made to open and admit the arm by means of a loose piece, which can be removed. The movable part is readjusted and secured by spiral pins, the idea of a hinge not having occurred to the native workman. The apex of the shell has a mammillary enlargement, which is cut off and made into a bead or button. Strings of these are commonly worn as necklaces by the Sepoys and others who wish to appear in uniform.

Among the Hindoos the chank shell is a sacred object, having a religious significance and value which render it essential to the prevalence of other devotions. Vishnu, the chief of the triad of Brahma, always appears with the sacred chank shell in his hand, and unless adorations are paid first to this symbol, all offerings are supposed to be rejected and worthless. The Hindoos entertain a belief in a general deluge, not very dissimilar to that described in the Mosaic record; and Vishnu, in one of his innumerable incarnations, assumed the form of a fish or a tortoise for the purpose of preserving the earth from destruction and restoring its beauty. In this renovation—known as the Lotus creation—Vishnu is represented as seated with imperturbable gravity upon the expanded petals of the lotus lily, emerging from the depths and bearing the sacred chank shell. In some old Indian paintings the shell is depicted with wings and surmounted by an open flower, while the other hand of the Deity contains the wheel, the symbol of the universe.

As the worshippers of Brahma are spread over large portions of India and China, extending into Thibet and Tartary, we find the chank shell regarded with superstitious reverence wherever Vishnu or his delegated power appears in the eastern world. The shell is converted into a wind instrument and sounded in the temples upon all occasions of ceremony. It is also used as an oil-vessel, or suspended as a lamp near the shrine of their gods. In this case it is usually carved with elaborate designs in the highest style of eastern art.

Upon the coasts of Tranquebar and Ceylon a sinistral variety is occasionally discovered, for which great prices have been obtained. Very few of the temples possess this rarity, which has been purchased with its own weight in gold. In China, it is said, the priests keep in this precious receptacle the consecrated oil with which the Emperor is anointed, and that the administration of medicine to the sick from the spout of this rare *Turbinella* will restore the patient to health when all other remedies have failed and recovery past hope. The discoverer of a reversed chank shell is considered as a mortal favoured above his fellows by the divinity whom millions adore. Reversed shells are not unfrequently discovered in some of the common species of the Mollusca, but some few genera exhibit this peculiarity with extreme seldomness. The left-handed arrangement among the chanks occurs so rarely that when a reversed variety appears the superstitious put upon it an extravagant value. In this country the sinistral variety seldom appears in collections of conchology, and seven or eight guineas have been given for this very uncommon object.

Note on the Binary Sub-division of Micrasterias Denticulata (Breb.), Ralfs.

By Stephen Helm, U.S.A.*

Plate X.

On Saturday, the 15th of June, at 10.45 p.m., I had the good fortune to perceive a solitary specimen of *Micrasterias denticulata* in a state of binary sub-division.

It had then arrived at what I will call the five-lobe stage, *i.e.*, the lobe on each side of the connecting central one had already divided, making five, which were as nearly as possible equal in size.

The lobe numbered 2 (Fig. 2) soon gave signs of lateral enlargement, and about 10.55 each top had a small but distinct heart-like depression (Fig. 3).

As the lobe became broader, this depression deepened until 11.30, when the division was completed, and well defined (2, 2*a*, Fig. 4). About 11.25 lobe number 3 (Figs. 2 and 4) on each side evinced signs of enlargement; and at 11.35 the before-mentioned heart-like depression was apparent.

I had by this time become deeply interested in this simultaneous quadruple growth, when to my intense disgust and disappointment, down came a *Cypris* and gobbled up my Desmid, and brought my observations to a summary conclusion.

I should not have deemed these observations worthy of record, but for the fact of their leading me to a conclusion somewhat different from that of the description of this Desmid, given by Carpenter and Hogg.

These authors state that the divisions are made in the following order: 1, 3, 5, 7 and 13, and that it takes place in about three and a-half hours.

* From "Journ. New York Micro. Soc."

Now, the time occupied by my specimen in multiplying from 5 to 7 was three-quarters of an hour, but, if I have been clear in my description, the enlargement and subsequent division of No. 3 (Figs. 2 and 4) must have continued, and have been completed, before 2 and *2a.* (Fig. 4) could have undergone the same process.

This being the case we should have had 1, 2, *2a,* 3, *3a,* (Fig. 5), or nine processes in all, or in other words, *one more stage* than is described by the authors referred to.

Both, however, seem to have drawn their inspiration from a paper read by E. G. Lobb, before the Microscopical Society of London—not then Royal—in 1861, and hence their descriptions agree.

For many years, I had the pleasure of being personally acquainted with Mr. Lobb, and, having spent many hours in his company, I knew him to be a careful observer.

I am therefore at a loss to account for the discrepancy.

One other fact makes it still more difficult, and that is, if you allow three-quarters of an hour for the divisions, and assume them to be 1, 3, 5, 7, 9, and 13, you have exactly three and a-half hours.

On the 20th of June I placed ten or twelve specimens in a special tank for the purpose, if possible, of solving my difficulty. But although I examined them almost every evening for two months, and could see their numbers increase to about forty, and could frequently perceive them in the last, or almost completed stage, I have not been fortunate enough to see the beginning, or the middle stage. The denticulation does not appear with the division of the lobes, but is probably coincident with the enlargement of the newly-formed portion of the Desmid, which is not at first so large as the original.

EXPLANATION OF PLATE X.

Binary sub-division of *Micrasterias denticulata.*

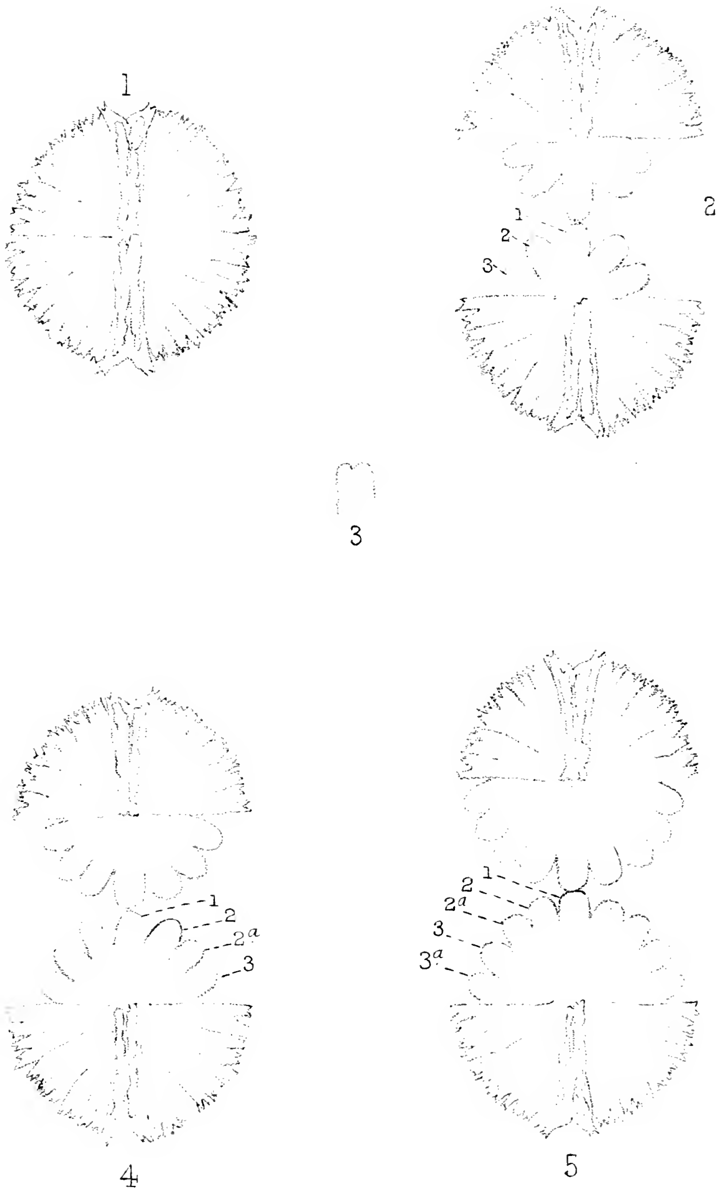
Fig. 1.—Completed Desmid ; the new, upper half not yet equal in size to the old lower half.

,, 2.—The "five-lobe stage."

,, 3.—"Heart-like depression" of a lobe.

,, 4.—The "seven-lobe stage."

,, 5.—The "nine-lobe stage." All figures × 150.



Micrasterias.

Elements of Microscopy.

I.—The Instrument.

By E. C. Bousfield, L.R.C.P., M.R.C.S., etc.

THERE are probably no fields of science in which so many workers are to be found as photography, microscopy, and astronomy, and these in the order named. The first and last of these are, however, so dependent upon external conditions of weather, light, and so on, that their pursuit is necessarily limited to favourable seasons, and astronomy especially, with the means available to most amateurs, offers only a limited field.

The microscopist is limited by no such considerations; given a spare hour, he can utilise it without difficulty. A lamp his sun, his temperature and weather at his own control, he is always provided with what he needs in this direction, whilst, as to objects of study, the range is so vast that with an instrument of but very moderate capacity no one observer can hope to exhaust the objects available for study and recreation, every one of which has beauties and interest of its own.

In astronomy the objects differ but little in kind, planets, fixed stars, nebulæ, groups, clusters, and meteors; these exhaust the classes of objects, and of these but few can be usefully studied; and the photographer finds himself in a very similar position. But the microscopist picks up a leaf, examines it, dissects it, observes the relations of its parts to each other, and to the functions which the whole has to fulfil; or an insect comes in his way, he studies its organs, notes their correspondences with and differences from those of other insects, and the way in which they fit the possessor for its position in the animal kingdom. A patch of blue mould becomes to him a forest of trees laden with fruit, a stagnant pool a veritable storehouse of forms of life, infinite in variety and beauty; a patch of mud raised by the anchor, or brought up by the lead of some sea-going vessel, yields to him forms of lowly vegetable and animal remains, which, by their exquisite grace and mathematical regularity of form, lead him to wonder whether any blind process of natural selection or survival of the fittest can have brought them to the state in which he sees them, and whether they are not, after all, direct expressions of the mind of a beauty-loving Creator. The rocks reveal their structure to the searching eye of his magic tube, with the forms of life they enclosed ages before man made his appearance upon the globe, and, in short, there is hardly a realm of nature, organic or inorganic, in which he may not find opportunities for study and research. Moreover, the applications of microscopy in business and everyday life are daily increasing in number, and where one microscopist was to be found twenty years ago, there are now twenty, and to many of whom the microscope is a means of earning their daily bread, whilst to very many more it is a source of constant pleasure, and mental, if not pecuniary profit. Of the latter class, probably only a minority take up any special line of study, and a still smaller number any original branch of investigation, but even to those who use it merely to gratify curiosity, or a love of beauty, there come lessons which, if rightly learned, are fraught with benefits, even if they be only those of neatness and accuracy in working, which microscopy is almost certain to engender.

Nor, as already said, is it essential to success, that the worker should be provided with all the latest, highest, and most expensive developments of the skill of the optician and mathematician working in conjunction; a steady stand, with good lenses of one-inch and one-quarter inch focal length, will enable him to do all ordinary and much special work, and such a microscope may now be purchased at a price which brings it within the reach of all.

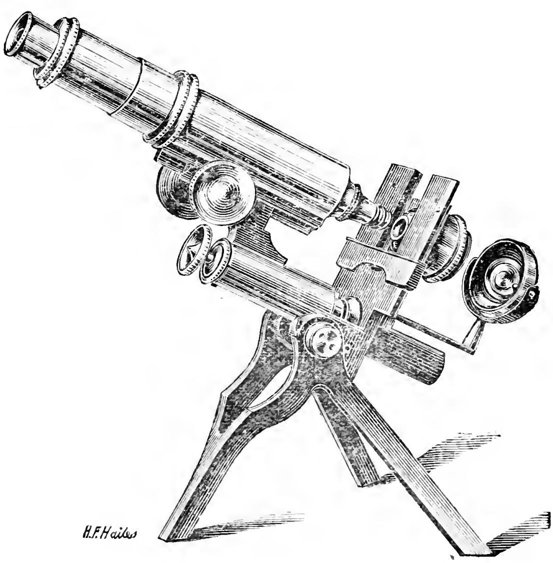
Our purpose, in this and succeeding papers, will be to show how such stands may be used to the best advantage. We shall take, first, a fairly good stand, of which class Baker's new Nelson model may be taken as the best representative; and then a cheaper stand, such as the Leitz model, or one of the ordinary English students' stands.

The essential features of a microscope, apart from the lenses—of which more hereafter—are the stand, tube, stage, focussing arrangements, and means of procuring illumination.

It is now generally admitted that the freedom from rocking, given by the tripod stand, entitles it to preference over all others, though to this must be added, that unless the triangle included between the feet be of sufficient area, there is much risk of over-turning; this point therefore requires attention. The tube should be of sufficient diameter, otherwise the field of view is seriously limited by the consequent smallness of the eye-piece, and this is the great disadvantage of the very small stands which are now sold; since a small eye-piece is, like a large one, most accurate at or near its centre, and the area of flatness of field becomes extremely small.

Of adjustments—*i.e.*, of means of focussing—there are usually two, the coarse and the fine, or, as they are often called, the quick and the slow motions. The coarse adjustment is, in the cheaper stands, often effected by a sliding arrangement, the tube of the microscope itself being moveable within a tube attached to the body of the microscope, but, except in point of cheapness, this plan has nothing to recommend it. On the contrary, many a valuable slide has been ruined by a sudden descent of the object-glass (which has also frequently suffered) to a point lower than had been calculated for or expected. The small extra expense of the rack and pinion is more than compensated by the facility and security in working obtained by its use. Not unfrequently the optical tube itself is made in two parts, the upper sliding within the lower, and this is in some respects an advantage, since it offers a considerable range of variation in magnification, without varying the eye-piece or objective employed, though, unless the tubes be of fair size, with a correspondingly large eye-piece, the advantage is counterbalanced by a great want of correctness in the outer portions of the field of view.

The fine adjustment, or slow motion, by means of which accurate adjustment of the focus is made, so as to secure the utmost possible sharpness of image, is of very varied character, and its arrangement depends somewhat upon the general construction of the stand. It would serve no useful purpose here to go into mechanical details, but the Campbell fine adjustment, it may be said, which is effected by means of a screw, which has two threads upon different parts of the same rod, working in opposite directions, has a great advantage in point of steadiness and wearing powers over any except the very best of the lever fine adjustments, if it be not indeed as good as any of them, and it is, moreover, not expensive in proportion to its goodness. The means of procuring illumination usually consist of a single concave, or a double plane and concave, mirror, upon an axis fixed below the stage. This, however, is usually of very inadequate size in small stands. This is a serious error, since the amount of light required to illuminate an object is by no means dependent on the size of the support upon which the object rests—*i.e.*, the stage. We shall suggest hereafter methods of overcoming this difficulty. About the stage itself not much need be said. It consists of a support, which should be absolutely level, fixed accurately at right angles to the body of the microscope, or at least to the axis of the optical tube, and so rigid as not to "spring" with any reasonable amount of pressure.



The simple form of the "Nelson" microscope, of which a cut is given, shows the various features above referred to in their best and most convenient form. The object of the somewhat unfamiliar shape of the stage is that, when working with high powers, the distance of the object from the lens may be judged by gently raising the slide with the finger, thus avoiding the risk of serious injury to both slide and objective, which is apt to occur, even in experienced hands, when sight alone is relied upon.

The stand has a wide, firm base. There is a rack and pinion coarse adjustment, a differential-screw, or "Campbell" fine adjustment, and the optical tube is so made as to lengthen or shorten at the will of the worker, whilst the sub-stage is provided with a tube to receive any optical apparatus for ordinary or polarized light, which it may be desired to use. The instrument has, in short, all the points of a sound, reliable stand at a moderate price, and to intending purchasers of limited means we can strongly recommend it.

But many of our readers will wish rather to know how to make the best of the instruments they have, than to be told of the excellences of one which they have not, and we forbear to expatiate at greater length on this portion of our subject.

Proceeding to work, then, we suppose the microscope to be put in position, with a lamp *in front* of it, and *not* at the left hand side as is so frequently recommended in text books. The edge of the flame should be directed toward the microscope, and a flat burner is infinitely preferable to the argand or ring burners so frequently employed. The size of the flame is not of material consequence; a half-inch paraffin-lamp wick, turned down until the bright part is about half an inch in height, will be found to yield excellent results when employed as we are about to describe, and is preferable to all other means of illumination, except daylight from a white cloud, when very low powers are employed. With such a lamp and such a flame as above described, a perfectly blinding amount of light can be obtained when properly managed.

For our own work we prefer to raise the microscope upon a block of such height as will enable the flame to be placed in the line of the axis of the optical tube, when the microscope is inclined, and the "Nelson" body is so hung as to allow of this being done without the block. As some of our readers, however, may not be provided with a microscope which can be inclined, and as the above method is only applicable with a sub-stage condenser, we describe here a method which can be applied to any stand. In any case the microscope should, if possible, be so arranged as to height that the centre of the mirror is on a level with the centre of the lamp flame. By this means the subsequent manipulations are rendered much more simple, since so many adjustments can be made without the position of the mirror being changed. Imagining then that the rays from the microscope are falling horizontally on the mirror, and that the microscope tube is inclined to the table at an angle of 50°, it is evident that the mirror must make an angle of 70° with the table in order that the ray may be thrown fairly into the tube of the microscope. We shall suppose the concave mirror to be used, and, whilst it is certainly not the best method of lighting, it will probably be most useful to the majority of microscopists if we indicate the method of using it to the best advantage.

A concave mirror has one *principal* focus, and the distance of this may be easily found by allowing the rays of the sun to fall upon the mirror, and noting the distance at which the image of the sun is sharply formed upon a *narrow* slip of paper held between the mirror and the sun. The slip must be narrow, in order that it may not obstruct too much of the light which falls upon the mirror, and should be opaque, in order that the image may be clearly seen. When the proper point is found the paper will be blackened by the concentrated heat rays.

The rays from the sun being parallel, the image will be formed at the *principal focus* of the mirror, which is always spoken of as being of this focal length, and the length in question is half the radius of the sphere, of which the mirror is a part. The sun not being always available for the microscopist's purpose, an alternative method may be useful. Setting up the lamp, with the flat side of the flame toward the observer, a cardboard box is put by its side, so that it is open toward him, with its bottom as far from him as the flame is, the two being close together. The mirror is now moved toward the lamp and box until the image of the flame is sharply defined on the bottom of the box. This distance from the mirror to the flame is the radius of curvature, and half the distance is the principal focus, of the mirror. The reason for this has to do with the first principles of optics, of which every microscopist should know something, and we trust our readers will follow us a little farther still. The point at which the image of the lamp flame is formed, and the point at which the flame is situated, are called conjugate foci. The nearer the flame is to the mirror, the farther off is the conjugate focus at which the image is formed, and it is, therefore, clear that by moving the lamp nearer to or farther from the mirror, we can so arrange matters that the image of the lamp flame shall be formed upon the object which we are examining.

Farthermore, since we have to deal (1) with a cone of light widening from the lamp and the mirror, and (2) with a cone of light narrowing from the mirror to the stage, it is clear that if we move the lamp farther from the mirror, and make the second cone shorter, we make its angle wider, since the base, which is the size of the mirror, always remains the same. Therefore, in working with low powers, of low angle, we make the cone between the mirror and the stage as long as we can, or as long as will do the work satisfactorily, and with higher powers we move the mirror closer to the object and put the lamp farther away from the mirror. Unfortunately, in stands such as are likely to be in the hands of many of those for whom we are specially writing, the distance of the mirror from the stage is a fixture. The only method available is then as follows :—Turning the mirror full on to the stage, measure the distance between mirror and object. Then turn the mirror round to face the lamp flame, setting the latter, with the cardboard box by its side, at the distance found to exist between mirror and stage. The lamp alone must then be moved away until its image is sharply defined upon the bottom of the box, and the distance between the mirror and the lamp flame thus found by trial must be adhered to in working, in order that the rays from the mirror may be brought to a focus upon the object.

We fear that the details given above may appear to be somewhat uninteresting, but after all, the microscopist who does not know a little of elementary optics is very much in the position of a carpenter who does not know how to adjust his plane. He will get shavings, probably, of some sort, but the resulting work will be of no higher class than that of the microscopist who sets his microscope up in a "happy-go-lucky" fashion, without any regard to the principles on which it is constructed, and of such, alas, there are far too many.

(*To be continued.*)

Zoological Notes at Port St. Mary, Isle of Man.

By A. Chopin.

NOT being able to get to Port St. Mary until late in the evening, I went to the Temperance Hotel, which I found most comfortable, and was well treated. The next morning I went out reconnoitring. The rocks on the left, between the two bays, looked promising, and I had a very pleasant walk in that direction, and later in the day strolled to the right of the town, and found the rocks there still more hopeful, so I felt quite at home after getting quiet lodgings at a place where I could have every convenience, a comfortable private room with an unlimited supply of pots, pans, basins, etc. Early next morning I went to the rocks on the left of the bay, but was quite disappointed, for the *Laminaria* was too much for me ; besides there was a kind of trench which prevented me from getting to the water's edge. However, to make the best of it, I took to uprooting the *Laminaria*, and looked for sponges and Tunicates, etc. Six of the former and four or five of the latter, with one or two Annelids, and a common Polyzoon, *Flustra foliacea*, were my stock of captures for that morning. I regretted very much I did not go to the other side of the town, as most probably I should have had better results.

I had set my heart on Anemones and Starfishes, and had not seen anything in that line at all. I went home and set to work to identify my stock. My first prize was a rare sponge, *Halisarca Dujardinii*, which pleased me very much as I had not seen it before ; afterwards I succeeded in naming all my stock with the exception of one sponge, which proved to be *Leucandra Gossei*. In the evening I went to the other side of the town ; there also *Laminaria*, forest-like, prevented me getting to the water's edge; of course, I felt much disappointed. However, I had the good fortune to find some rock pools, where I got a specimen of *Sagartia bellis*, and saw (which pleased me very much) *S. nivea*. There were three specimens, only I could not get at them, being too low down in the pool, but I felt certain I could not be mistaken. No other Anemone has tentacles and disc white, so I got rather better pleased, and my spirits rose somewhat, but nothing else could I get but a Tunicate and one or two Polyzoa. The next day, Tuesday, was nearly a blank, and to make the thing worse, the next morning was very wet—my spirits sank to a very low ebb.

But next day I went out dredging, and my spirits speedily revived, for Pipe-fish, Shrimps (two species), the common *C. vulgaris,* and the other a fine species, *Steiracrangon Allmanni*, Hydrozoa, Polyzoa, and two spider-like crabs. I thought this a great success, and my little dredge did marvels. I said to my friend, the fisherman who was with me, I should have liked to have had a Starfish or two, but perhaps we shall be more lucky to-morrow; says he, "If you want Starfishes come with us to the Calf of Man lobster fishery." Of course I agreed, so we started for the Calf at 2.30 a.m.; the sea was a bit rough. The first pot we lifted had a little bit of something hanging to the bottom of it, and on looking closer I found it was a Feather Star; all the pots but, I think, two had Feather Stars attached to them, but many were broken in taking them off. However, I succeeded in getting about a dozen, and left fully as many on the baskets. I secured also many Polyzoa and Hydrozoa which, I am glad to say, proved good ones; the best was yet to come. We went about one mile off the Calf of Man, in the open channel, to lift the pots, but could only get at one, although they had two close together, for the sea was anything but still, and the other could not be seen; the pot (and you know the size of these so-called pots) was covered all round with Brittle stars, three or four thick. There must have been several hundreds, and among them were dozens of *Galateas*, and one Crab, *Coarctatus*, a beauty of a most lovely flesh colour, and altogether like wax. My best Hydrozoa, *Hydrallmania falcata*, and *Diaphasia attenuata* came up entangled in the rope. I must not forget the pretty red shrimp, *Pendalus annulicornis*, and the little two-spotted sucker, a most magnificent lot. We had one or two more pots about the Calf to lift, but the sea got so rough that we had to leave them as they were and run. A half-hour's stiff sailing brought us home heavily laden, the fishermen with crabs, lobsters, and whelks, and I with such a lot as would make anybody pleased to gather the like in a week.

In passing I noticed some fine caves, and intended to have a run there the next day, but the weather did not give me a chance, and kept rough until Saturday. I had another attempt at dredging on Friday, but was not very successful. I had then an offer to go trawling, but was obliged to refuse as I had to leave on Saturday morning. I went to have another look at the S. Niveas, and see what else I could do on the rocks. *Crassicornis*, *S. miniata*, and *Bunodes Gemmacea* were the results of my last day.

I came home laden with spoil, but unfortunately some of my best stock did not live more than two or three days.

The following is a complete list of my captures, viz. :—

CRUSTACEA.

Phonilus Spinosus
Nymphon Gracile
Idotea Marina
,, *Linearis*
Talitrus Locusta
Pendalus Annulicornis
Crangon Vulgaris
Steiracrangon Allmanni
Homarus Vulgaris
Galathea Dispersa ?
Pagurus Bernhardus
Carcinus Mœnas
Cancer Pagurus
Hyas Coarctatus
Stenorhynchus Rostratus

POLYZOA.

Aetea Recta
Aetea Truncata
Lucratea Chelata
Scrupocellaria Scrupea
,, *Reptans*
,, *Scabra*
Bugula Murayana
,, *Flabellata*
Flustra Foliacea
Membranipora Pilosa
,, *V. Dentata*
Schizoporella Hyalina
Mucronella Peachii
Crisia Denticulata
Tubulipora Lobulata
Alcyonidium Hirsutum
Vesicularia Spinosa
Pedicellina Cernua

TUNICATA.

Amaroucium Proliferum ?
Leptoclinum Maculosum ?
Distoma Rubrum
Botrylloides Rubrum ?
Botryllus Violaceus

PORIFERA.

Halisarca Dujardinii
Amorphina Panicea
Hymeniacidon Sanguinea
Oscaltis Botryoides
Leucandra Johnstoni
,, *Gossei ?*
Sycandra compressa

CTENOPHORA.

Pleurobranchiata Pileus

HYDROZOA.

Clytia Johnstoni
Obelia Geniculata
,, *Gelatinosa*
,, *Flabellata*
,, *Dichotoma*
Campanularia Caliculata
,, *Verticellata*
,, *Angulata*
,, *Neglecta*
,, *Integra*
Halecium Halecinum
Diphasia Attenuata
Hydrallmania Falcata

ACTINIARIA.

Sagartia Bellis V. Modesta
,, *Miniata V. Ornata*
,, *Nivea V. Immaculata*
Actinia Equina V. Rubra
,, ,, *V. Umbria*
,, ,, *V. Olivacea*
Tealia Crassicornis V. Insignis
Bunodes Gemmacea

ECHINODERMATA.

Comatula Rosacea *
Uraster Hispida v. Asterias hispida
,, *Violacea*
Ophiocoma Minuta
,, *Rosula*
Echinus Esculentus

ANNELIDA.

Serpula Vermicularis
Nereis Pelagica
Spirorbis Borealis
Harmothoë Imbricata

CONCHIFERA.

Syndosmia Alba

GASTROPODA.

Chiton, sp.
Ianthina Communis
Trochus Cinerarius
,, *Tumidus ?*
,, *Zizyphinus*
Littorina Littorea

PISCES.

Syngnatus Anguineus
Lepidogaster Bimaculatus

* This Rosy Feather Star had one curious long finger, twice the normal length. It has been requested by Prof. Jeffry Bell for the British Museum, Natural History Collection.

A picturesque Lake-dwelling has just been discovered under a peat-bog near Milan, which differs in many respects from those previously discovered in Switzerland and Upper Italy. The posts are still standing upright, and the planks have been made by roughly splitting trees without the use of any kind of saw.

Aspect of the Heavens: April, May, June, 1890.

By A. Graham, M.A., etc., Cambridge Observatory.

THE most striking phenomenon which can be predicted for this Quarter is the Annular Eclipse of *the Sun* on June 17. Seen from the centre of the earth on that day at noon, the sun's diameter subtends an angle of 31 min. 33 sec., that of the moon only 29 min. 53 sec.; so that, even where the moon will appear centrally over the sun's disc, a narrow margin of the sun will appear as a ring of light round the edge of the moon: hence the origin of the title Annular Eclipse. This Annular Phase begins on the earth generally at 8*h*. 2*m*. in the morning, Greenwich mean time, in the Atlantic Ocean, longitude 32° 30′ west of Greenwich, and latitude 5° 8′ north, crosses the northern part of Africa, the Mediterranean Sea, and the south of Asia, and ends 12 minutes before noon near the east coast, in longitude 101° 25′ east, and latitude 18° 46′ north. A partial eclipse will be visible for more than 30 degrees north and south of this central line, including the whole of Europe and a large part of Africa and Asia. At Greenwich the phenomenon begins at 8*h*. 20*m*., and ends at 10*h*. 31*m*. in the morning; at 9*h*. 23*m*. a little over one third of the sun's diameter will be covered.

The Moon will be *full* on April 5 at 9*h*. 24*m*. morn., May 4 at 9*h*. 9*m*. aft., and June 3 at 6*h*. 34*m*. morn.; *Last Quarter*, April 12, 10*h*. 53*m*. morn., May 11, 4*h*. 22*m*. aft., June 9, 9*h*. 50*m*. aft.; *New*, April 19, 8*h*. 5*m*, morn., May 18, 8*h*. 19*m*. aft., June 17, 9*h*. 58*m*. morn.; *First Quarter*, April 27, 4*h*. 52*m*. morn., May 26, 10*h*. 34*m*. aft., June 25, 1*h*. 54*m*. aft.

She will be in *Perigee*, or nearest to the earth, on April 13 at 6*h*. aft., May 8 at 10*h*. aft., and June 5 at 10*h*. morn., and in *Apogee*, on April 26 at 6*h*. aft., May 24 at noon, and June 21 at 4*h*. morn.

On June 29, one minute before 10 in the evening, a double star in Scorpio, second magnitude, will disappear behind the moon, and will reappear at 13 minutes past 11.

The Moon will be in conjunction with *Mercury* on April 20 at 4*h*. morn., on May 20 at 1*h*. morn., and on June 15 at 6*h*. aft.; with *Venus* on April 20 at noon, on May 20 at 8*h*. aft., and on June 20 at 4*h*. morn.; with *Mars* on April 9 at 2*h*. aft., on May 6 at 8*h*. aft., and on June 2 at 4*h*. aft.; with *Jupiter* on April 13 at 1*h*. aft., on May 10 at 11*h*. aft., and on June 7 at 6*h*. morn.; with *Saturn* on April 1 at noon, on April 28 at 7*h*. aft., on May 26 at 5*h*. morn., and on June 22 at 3*h*. aft.

Mercury will be in superior conjunction with the sun on April 9 at 8*h*. morn., and after that will recede eastward from the sun until May 6, when it attains its greatest elongation 21 degrees eastward, and may be seen near the horizon, north of west, as a small but brilliant evening star; it then begins to approach the sun, in the part of its orbit nearest the earth, and reaches inferior conjunction on May 30 at 4*h*. morn., when it passes nearly between us and the sun, and recedes westward until June 24 at 9*h*. morn., at which time the angular distance will be 22 degrees westward, but its declination being lower than that of the sun, it will hardly be visible as a morning star to the naked eye. *Mercury* and *Venus* will be in conjunction on April 26 at 5*h*. morn. at a distance of 2 degrees, and again on May 10 at 7*h*. morn. at nearly the same distance; a conjunction of *Mercury* with *Neptune* takes place on June 10 at 2 in the afternoon.

Venus begins to be visible toward the end of April as the evening star; but being in the remoter part of its orbit it will not be so bright as on other occasions. Seen with a telescope it is gibbous. It will be in conjunction with *Neptune* on the 5th at 9 in the morning.

Mars will be in opposition to the sun on the 27th at 7 in the evening. It crosses the meridian on the night before precisely at mean midnight, at the low altitude of 15 degrees. On the afternoon of the 23rd it will be in conjunction with Antares—the bright reddish star in Scorpio. The planet will be about 3 degrees north of the star. The conjunction of two objects, to the naked eye so similar in appearance, in the telescope so different, is rather striking.

Jupiter, though rather low in the south, is conspicuous as the morning star. It is now in Capricorn. The apparent motion among the fixed stars is eastward till the end of May, when it begins to retrograde.

Saturn is very near *Regulus*, the bright star in Leo. It recedes very slowly westward from that star until the 29th of April, when the distance will be about 2 degrees; it then approaches and overtakes the star on May 30, and, passing it, continues its course eastward.

An Italian astronomer, Schiaparelli, has been carefully observing the markings on the disc of the planet *Mercury*, and has come to the conclusion that the planet rotates on its axis in the same time that it revolves round the sun. If this be the case, we have the singular arrangement of a planet with a great part of one hemisphere in total darkness, and a great part of the other exposed to perpetual sunshine. It is to be hoped that with some of the large telescopes now in use this remarkable conclusion will be tested.

New Objective of 1·63 N.A.

THOSE of our readers who may have become possessed of one of the recent Apochromatic Objectives of 1·4 N.A., will be interested in hearing of a lens of still wider aperture. This new objective of 1·63 N.A. has been constructed according to the formulæ of Professor Abbe, in the optical factory of Carl Zeiss. The immersion is not really homogeneous, but is of monobromide of naphthaline, whose index is 1·65, the front lens of flint glass (index 1.72), while the cover-glass, into which the preparation has to be melted, is of the same material. The condenser must, of course, as indeed should be the case with all objectives, be of the same aperture. The covers have to be ground down to the required fineness, and carefully polished; hence they are very costly. So far, diatom valves have been found the most suitable objects for such a method of mounting, owing to their practical indestructibility. The only difficulty in the way of increasing even this wide aperture, lies in the need for a suitable immersion liquid. Dr. Van Heurck has used this new lens for some weeks, and speaks very highly of its resolving and illuminating power. He has also managed to apply it to some of the bacteria. The focal length is 1-10th inch, and the mounting medium has an index of 2·4. In oblique light, *Amphipleura pellucida* is entirely resolved in beads, and it is seen to have 3,600 transverse, and 5,000 longitudinal striæ per millimetre. No wonder these beads have hitherto been so difficult to resolve. Only three of these wonderful objectives have been made, and as they cost £400 each, it is not likely there will be a great demand for them. But as they are in the hands of a few experts, we may hope for the eventual solution of a few microscopical problems.

The Preparation of Desmids.—We have received a valuable communication from Mr. W. H. Walmsley, of Philadelphia, on this subject. We are thankful to Mr. Walmsley for his kindly and appreciatory remarks on the Article in our last No. on *Desmids and Volvox*. As this gentleman has spent many years on this kind of work the following extract from his letter may be of service to some of our readers :—

" Having been perfectly successful in preserving the colour in many of our fresh-water Algæ, it may be that the same method would prove successful with Desmids. My plan is simply to have a wide-mouthed bottle, with glass stopper, filled with distilled water, in which I have a number of pieces of Camphor. When it is desired to mount the Algæ, I place a portion of the same in some of this camphorated water, to which a few drops of glycerine have been added, in a watch glass. At first it will become a yellow lemon colour, but after a few hours the original green returns in its full vividness, and then I at once mount in a shallow cell, with a portion of fluid. *Draparnaldia plumosa* thus mounted twenty years ago, is to-day as beautifully green as at first, and the chlorophyll seems to be unchanged."

Hantzch, as we said, uses alcohol instead of camphor, in order to get the proper specific gravity for the medium, and so prevent contraction of the cell.

Wesley Naturalists' Society.

THE ANNUAL SOIREE was held as usual in the Centenary Hall, London, late in December. During the evening there were limelight lantern lectures of a popular scientific kind, and exhibitions of electrical experiments, microscopes, spectroscopes, and other objects of great interest. The first part of the proceedings included addresses by the Chairman, Mr. John Beauchamp (who has ever been a kind and practical friend of the Society), Dr. Dallinger, the distinguished President, and Rev. John Scott Lidgett, M.A.

Mr. Beauchamp reminded the audience that many good people had been under the impression that religion would suffer if there were much intercourse with the world or much study of the works of nature. In very early times good men, for this reason, left society and retired to a hermit life in the desert. When that kind of life became intolerable, men built monasteries and retired thither from the world. But after a time it was found that the evils generated by the monastic life were greater than those to be found in the busy world, and gradually the monasteries were closed. At another time the study of literature and the classics was said to be injurious to religion; but gradually it was recognised that, after all, learning was no hindrance to religion. In later times it was thought to be harmful to engage largely in business; but this feeling, too, had disappeared. Lastly, politics were forbidden. Some people still thought that religious men should keep clear of politics, but happily that idea was passing away; and it was now generally held that it was the duty of a godly man to interest himself in the right government of his country. Now this Society had been founded to protest against the idea that science and irreligion necessarily go together.

Dr. Dallinger expressed his conviction that if John Wesley were living he would be occupying the position of President of this Society, for there was no subject in which John Wesley felt a profounder interest than that of the laws of Nature; and he insisted that if we would understand Nature we must be simple students at Nature's feet. It was easy to see that he realised the true dignity of manhood. While he fully recognised the obligations and necessities of the body, he was profoundly sensible of the obligations and necessities of the mind; and as he rose to a perception of man's spiritual nature and the great Centre of the universe and its source, he did not allow his perception of the human mind to be obscured by the perception of that which was the higher part of it. This does not extinguish intellect, with its potential responsibilities; it only quickens it, and opens new realms in which he can constantly expand it. Moreover, it is the very means by which the intellect may be more thoroughly filled with the luminosity which will keep it clear in its direction towards God. Sterility is begotten of prejudice. The Church was robbed of music in one of its forms, and we are robbed of many other things, simply because the prejudices of men have suddenly gone in a different direction. Now, my perception of religion is that it is the central light of our nature. It must diffuse our entire being, touch our senses, touch our intellect, and fill our spiritual nature with its true vitality. Can, then, a man be less capable of searching into Nature because he feels that God is his Father? Surely not. It was not faith, but cowardice, Dr. Dallinger argued, which led a man to say: "Stop! we can go no further," directly he meets something in Nature which he cannot understand. He condemned the shallowness of those men who, unless they could see everything, believed there was nothing to be seen; and to further confound their unbelief the Doctor pointed to the many things revealed by science in the last fifty years, leading men to see that He who is perfect could only create what is perfect. There was unity of perfection, adjustment, and adaptation everywhere, and if in the interpretation of that unity man sometimes stumbled for want of knowledge here and there, was he to say, "Do not search any more—you will lose your faith"? Or should he not rather buckle on the armour and work ahead, in the confidence that light would come in the end? It is because I believe in God that I am not afraid. It is because I know that I am finite and God is infinite that I fear not. Though I stumble and fall I get up again and try to recover myself from the bruises, and in the darkness I work on, knowing that there is light and that there is reconciliation beyond. We who realise the certainty of the spiritual life have no fear of any investigation of nature, nor of any complex difficulty that may present itself in the course of the investigation. My deep desire is that this Society should be the means of boldly and fearlessly expressing to society at large in this country and America that we who deeply and profoundly believe in the spiritual life of man and in the salvation that has come to us in Christ are not in the slightest degree afraid of the advance of science, but, on the contrary, that we do what we can to advance it more rapidly without fear of the issue.

Rev. John Scott Lidgett, the next speaker, outlined the work which would be undertaken in the proposed settlement in Bermondsey, and pointed out how the Wesley Scientific Society could assist in that work.

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Circulation of Specimens.—Members are reminded that if they wish to receive specimens, they must apply to the Referees. Most of the Referees state that very few, so far, have made application. It is hardly possible to work on the new plan, unless at least half-a-dozen join a Section. Referees, however, are at liberty to adopt any other plans that they may prefer. Many of the Referees are greatly interested in their Sections, and would be glad to receive more names. Several, indeed, are working their Sections with fewer names than they would like to have, in order to keep up the interest, and in the hope that others will gradually join. Probably many members have lost confidence in the circulation scheme, owing to the great irregularity and losses of last year, but it is believed that under the new scheme there would be much more regularity. It might be advisable, too, for the Referees to send a circular to former members of their Section, suggesting that in lieu of the 2s. 6d., a certain number of slides should be lent for circulation through the Section. We would appeal to members to do all they can to keep up the interest in this educative work.

Purchase of Microscopes, etc.—Several letters have been received respecting the purchase of Microscopes, and other scientific apparatus. Frequent opportunities occur for the purchase of such articles, at greatly reduced prices. Some arrangement may possibly be found practicable, by which costly apparatus could be obtained by easy instalments. One aim of the W.N.S. is to popularise science, and such a scheme would certainly be considered as coming within its proper scope. Members feeling any interest in this matter, or who desire to buy or sell instruments, are requested to write to Rev. F. W. Shirley, Rosslyn House, Provost Rd., Dundee.

The Rev. W. Spiers, M.A., has two volumes in the press which will shortly appear, one consisting of a series of natural history sketches, entitled "Rambles and Reveries of a Naturalist," with illustrations; the other on "The Sabbath," some portions of which deal with the subject in its relations to geological teachings on the question of creational epochs. Both volumes are being published by the Wesleyan Conference at 2s. 6d. each.

Circulation of Periodicals.—Two more names are required to complete the list for *Nature*.—Address W. Symons, F.C.S., Bilbrook near Taunton.

Wanted, No. 1 *Wesley Naturalist*, March, 1887, in exchange for two good Mounted, or twelve named good, Unmounted Micro Objects.—Chas. J. Watkins, King's Mill House, Painswick, Gloucestershire.

Half-an-Hour at the Microscope,

With Mr. Tuffen West, F.L.S., F.R.M.S., etc.

Section of Spine of Echinus.—There are a large number of species. To give this slide its true specific value, the locality whence obtained should be named. With this drawback it furnishes an admirable example of structure, the most complete description of which was furnished by Dr. Carpenter to one of the early meetings of the British Assocation, and will be found in the Vol. of "Reports" for the year, along with the most exquisite illustration (by W. S. Leonard) that has yet been given of it.

Palate of Limpet.—It is a real treat to see this fine specimen in its entirety. The lingual ribbon is, however, not coiled so much as is here represented, and as the necessities of fitting to the slip of glass require, but (speaking from memory) I believe the coil is only about once round inside the shell.

Pycnogonum.—I had been wishing that some representative of these remarkable forms of life should be passed round, and here is the unspoken wish gratified. R. H. M. will not be able to see the contractile cœca after they have been removed by potash; they are indeed curious and interesting.

Ammothea Pycnogoniodes.—G. Hodge, who has studied the British Pycnogons more than anyone, and gives a list of all so far as then known (Tyneside Trans., Vol. VI., Pt. 2, 1864, p. 198), only enumerates two species of the genus—"*A. brevipes*," which this appears to be, and "*A. longipes*." Prof. Allman has described a similar parasitism on Coryne in this genus (Brit. Association Reports, 1859). The number and character of the claws furnish important aids in the discrimination of generic and specific characters; both the examples of Pycnogons in this box have *three*; one very large and strong, the other pair situated behind and external to it, and more or less rudimentary. The parasitical attachment of diatoms is curious and interesting. The species are "*Grammatophora marina*" and "*Cocconeis scutellum*," the latter sparingly; also a *Synedra* and a *Biddulphia*. Perhaps this sort of thing may be more common than is at present supposed. I found to my astonishment this summer a complete scale armour of diatoms on some brackish-water larvæ, mostly *Cocconeis Placentula*.

The mouth is suctorial in its character. It appears to consist in this *Ammothea* of an upper and under lip, a pair of mandibles, and a pair of maxillæ, the whole together forming a tube; a central thick-walled pharynx, doubtless furnished with powerful muscles and a beautiful structure at its base for facilitating contraction and expansion.

The exact position of the Pycnogons in the animal kingdom has been a subject of much controversy. There can, however, I think, be no doubt that they are rightly placed with the Crustacea, and are not Arachinda. The study of the development completely proves this.

The sensory hairs on the limbs of *Ammothea*, their special development at the elbow-joints, and their mode of implantation, are points worthy of careful study in connection with the dense integument.

Hypopus muscorum—We are here presented with a physiological puzzle, which from the interest attaching to it, demands our best consideration. What is Hypopus?

According to received authority it is an Acarine parasite found on flies, not uncommonly, although generally believed to be rare, and supposed to be a larval condition of *Gamasus Coleoptratorum*, the fellow sent round on Dr. H.'s interesting slide of "Parasite of Watchman Beetle." See *Hypopus* in Micro-Dic.

In November, 1869, G. J. McIntire, in a highly interesting paper on *Pseudoscorpions* (which appeared in *Sci. Gossip*) published a short account of the life-history of a species of Hypopus, which had come under his notice as a parasite on *Obisium orthodactylum*, one of the Chelifers. He was, I believe, the first to observe them living. A tolerable figure was given of this, and another, a larger species, casually mentioned. The same author read a paper (*Monthly Micro. Jour.*, Jan., 1874, p. 1) headed "Notes on so-called Acarellus," before the Roy. Micro. Society, in which he details observations which seem to all but prove that the species of Hypopus which have come under his notice, are a stage in further development of Acari resembling Cheese-mites. The species he so nearly traced out, was found in its early stage on a decayed potato. "About this time (1869), I noticed that many cells were infested with another Acarus" (than the Hypopus of the Obisium) "very like a Cheese-mite." "A group of half-a-dozen of them would be seen devouring the decaying malt and other substances; in fact, wallowing in the filthy mess they made, like so many pigs; and in some cells all the corners where the pabulum of the Poduræ, or their excrement had accumulated, were occupied by similar groups of these disagreeable-looking Acari."

Two years ago, however, in the month of September, I picked up a decayed potato, which had such a large population of these Acari upon it, that I was induced to give it some close scrutiny, chiefly with the view to satisfy myself whether these mites were the so-called "Cheese-mites" (*Acarus domesticus*), or another species. I soon saw that there was a remarkable change going on in the case of the greater number of them. They were casting their skins, and when this operation was complete, they had metamorphosed into my other little friends, the *Hypopi.*

McIntire saw the Hypopi, now probably blood-suckers, leave their host's back (the Obisium), and wander over the floor and sides of the cork-cells, and found that when they died, they drew up the two hind pairs of limbs, so as to be scarcely visible, and to give the appearance in mounted specimens of Acari with only four legs.

Now, it appears that Westwood in July, 1870, described two species of Acari having *apparently* only the two anterior pairs of limbs under the generic name of *Acarellus.* In December, 1872, was published in the *Monthly Micro. Journal*, a paper by J. G. Tatem, on two more species of the supposed new genus *Acarellus.*

Most mites in their early stage have, so far as known, only six legs, acquiring another pair as they reach the mature condition. There is no *à priori* reason why there should not be mites born with only two pairs of limbs; but McIntire's observations seem to render it very doubtful (to say the least) whether, if there be any such, they have as yet been found. McIntire points out the difficulty in giving credence to so great a change in the mouth-organs, as that from the suctorial one of *Hypopus*, to the mandibulate (or chelicerate at any rate) form in Gamasus, but with the surprising transformations already known to science, it will not do to allow too great weight to such an argument. A stronger one I believe to be, that the young of Gamasi may be found in pedicellate ovisacs on the Watchman beetle; such I take to be the "*Uropoda umbilica*" of Curtis ("Farm Insects," pp. 199, 398). The subject will be found a most interesting one in its various bearings, and I can only commend to our members the thoughtful perusal of the various papers mentioned, which may help them to form conclusions of their own on the subject, and, it may be, stimulate independent research.

Spider.—It is often a very difficult task to give the names to *mounted* specimens with certainty, and it is one from which cautious men shrink through fear of committing themselves. The one before me is, however, so characteristic, that I do not think there is much risk in naming it a male example of "*Tetragnatha extensa*," which will be found described at length in Blackwall's British Spiders (Ray Soc. Trans., Vol. II., p. 367, and figured on Pl. XXVIII., Fig. 265.

In examining a spider, the best plan is to pop it for a brief period into gin; then take it, and holding it on one of the old-fashioned microscope forceps having a *weak* spring, by the two hinder legs of the left side, examine first the eyes with a lens of sufficient power, noting carefully their number, form, and arrangement; the form, etc., of the Cephalothorax. Then look to the parts of the mouth, the falces, maxillæ, lips, sternum; gently extend the limbs, noting their relative lengths, which measure with a pair of compasses, and finely divided scale. If a male, the palpi, and form etc. of the palpal organs must be specially observed. The colour, markings, pubescence, with anything else that may seem likely to help in the determination, must also be noted, and then with the help of Mr. Blackwall's work, in which all are figured of which specimens could be obtained at the date of publication, the determination will generally be found tolerably easy.

The eyes here stamp the specimen as belonging to the *Epeiridæ*. The length and slenderness of the limbs bespeak it as no other than *Tetragnatha*, which is confirmed by the character of the claws, the falces, the mandibles, lip, and sternum; form of abdomen and colour are, it must be said, as a matter of course lost. The palpal organs differ so much in their appearance when made transparent from what they do in their living or recently dead state, that one can only say, so far as characters can be gleaned from them, they confirm the previous determination. I may point out, as microscopically interesting, the remarkable clearness of the openings in the fangs for exit of poison, the sac for storing which may be seen on the right fang (left as mounted, it being presented on its back); the striation of the muscular fibre in the falces, the small size of the abductor, as compared with the abductor muscle, the meaning of which will be apparent on considering their uses; the beautiful fringe of teeth on the anterior edge of the maxillæ; compare these with the teeth of the leech, shown in T. D. A.'s interesting slide.

I never before saw so clearly what must be the action of the maxillæ in a spider of cutting, like the scarifier used in Cupping, into the soft body of their prey. The juices as they flow on are pressed out, being absorbed by the fringes of hairs, as a sponge, whence they are drawn by suction into the body of the spider; these hairs having (from analogy, we may say with certainty) tasting powers as well.

The horny œsophagus and stomach are also well shown, and (if I mistake not) nerves going to supply the limbs and viscera. The beautiful "fluting," or spiral grooving of the spines, the slight serration of the ordinary hairs, guards to the softer parts, the tactile hairs to warn of danger, softer, and standing boldly out almost at right angles to the limbs, and the varying modes of implantation of these respectively: all are points worthy careful study. It only remains to mention the beautiful structure of the claws for combing the creature's body and its lines, and the *sustentacula*, claw-like hairs seated beneath the claws proper, to enable the creature to hold on for hours in the inverted position without muscular effort or fatigue, and we have the principal points shown by Mr. Kingdon's capital specimen.

Parasites of Pycnogonum are really the young, as suspected by Mr. Nicholson. F. B. K.'s notes and sketches, with reference to G. Hodges' paper in the *Intellectual Observer*, require little further observation than to say that G. H.'s original paper on the singular mode of development will be found in the "Transactions of the Tyneside Naturalists' Field Club," Vol. 5, Part II, p. 124. It would appear from this that the young, having arrived at the stage so well shown by A. Nicholson, free themselves from the parent, and are carried by the waves into rock-pools, inhabited by a species of Coryne, one of the Sertularian Zoophytes. By one of these Zoophytes a young Pycnogon is swallowed (the species observed was *Phoxichilidium coccineum*), and passes, or is passed, on to the end of a growing branch. Here a sack is formed, in which it stays as a gall insect in its artificial excrescence, growing rapidly on the store of nutriment constantly furnished by its foster-parent. Having attained, after two or three moults, to a condition in which it is able to set up in the world on its own account, it breaks out from the walls of its temporary home by means of its strong foot-jaws, and sprawls away in search of food and shelter, in due time to reproduce its kind.

Reviews.

THE NEW ENGLISH DICTIONARY. Edited by James A. H. Murray, LL D., etc. (London : H. Frowde, Clarendon Press.)

A fifth part of this noble and invaluable work is before us. The dictionary embraces all words in the English language, which are in use now, or have been used during the last 900 years, and the present part reaches from CAST to CLIVY. This part alone contains 5,966 main words, 1,031 combinations with separate explanations, and 1,374 subordinate words, making a total of 8,371 words. In the entire course of the five parts now published, no fewer than 45,391 words have been treated. Truly, this is a great work.

A CONTRIBUTION TO THE FLORA OF DERBYSHIRE. By the Rev. W. H. Painter. 8vo, pp. 156. (London : George Bell and Sons. Derby : E. Clulow, jun. 1889.) Price 7s. 6d.

A very full account is here given of the Flowering Plants, Ferns, and Characeæ found in the county. The descriptions are systematically arranged. In the introduction a short account of the Geology of Derbyshire is given, and its relation to the Flora of the county is pointed out. There is also a well-engraved map of the county.

INDEX OF BRITISH PLANTS according to the London Catalogue. By Robert Turnbull. 8vo, pp. 98. (London : George Bell and Sons. 1889.) Price 3s.

The purpose of this book is to furnish a complete Index of British Flowering Plants and Ferns. It is based upon the eighth edition of the *London Catalogue*, and contains all the names there found, together with all the additional names of species, under which descriptions are given in most of the best-known English botanical works. We think it will be found very useful to the botanist.

The Birds of Oxfordshire. By O. V. Aplin. 8vo, pp. vii.—217. (Oxford and London: The Clarendon Press. 1889.)

We have before us the result of many years' labour of the author, who gives in this volume a considerable amount of information relating to the birds of the county. The first 22 pages are devoted to a general description of the county. A coloured plate, representing the Alpine Chough, forms the frontispiece to the volume. There is also a good map of Oxfordshire. The work will prove to be a valuable addition to our local histories of British birds.

The Bala Volcanic Series of Caernarvonshire and Associated Rocks. By Alfred Harker, M.A., F.G.S., Fellow of St. John's College, Cambridge. (Cambridge: University Press. 1889.) Price 7s. 6d.

Mr. Harker, having gained the Sedgwick Prize for 1888, has entirely rewritten the essay, and has published it in the present form. It is not attractive reading for any but serious geologists, but such as these will find it a very useful guide to the study of an interesting locality. It is well illustrated with geological sketch-maps of the various localities visited by the author, and a good deal of original work is described.

Cosmic Evolution. By E. A. Ridsdale. Foolscap 8vo, pp. 130. (London: H. K. Lewis, 136 Gower Street.) Price 3s.

This is from the pen of a firm believer in evolution, and he treats the subject from its chemical and from its organic aspect. There is nothing strikingly new in the book, but there is a very clear and full statement and elucidation of the theory of evolution.

The Animal World: An Advocate of Humanity, Vol. XX. (London: S. W. Partridge and Co. 1889.)

This most entertaining work is issued by the Society for the Prevention of Cruelty to Animals. It is our firm belief that if those who keep animals would read this book there would be no further need for the Society by which it is issued. It is freely illustrated and the illustrations are good.

Summer Suns in the Far West. By W. G. Blaikie. D.D., LL.D. Crown 8vo, pp. 160. (London and Edinburgh: Thomas Nelson and Sons 1890.) Price 2s.

Dr. Blaikie gives the reader an interesting account of his most enjoyable holiday trip to the Pacific Slope. In the course of his tour the author visited Baltimore, Chicago, the Colorado Rockies, the Salt Lake City and the Mormons, the Yosemite Valley, British Columbia, the great Canadian Highlands, Niagara, etc. The reader will wish he had accompanied him.

Idylls of the Field. By Francis A. Knight. Crown 8vo, pp. vi.—182. (London: Elliot Stock. 1890.)

Every lover of nature will read this little book with delight. It is written by the author of "Leafy Ways," and of the 24 chapters into which the book is divided it will be difficult to say which is the most interesting. There are also 15 illustrations.

The Ocean of Air: Meteorology for Beginners. By Agnes Giberne. Crown 8vo, pp. xii.—340. (London: Seeley and Co. 1890.) Price 5s.

This is a most interesting and instructive book on a subject concerning which there is much ignorance. The uses, movements, forces, organisms, and composition of the air are all explained in a most simple and yet accurate and exhaustive manner. We would advise all to buy and study this book who wish to know about that important vast ocean, or rather world, which envelops our earth, and which has so much to do with the life, health, and happiness of its inhabitants.

THE OXFORD PLANISPHERE. By C. Pritchard, D.D., F.R.S. (London: Henry Frowde, Clarendon Press Warehouse. 1890.) Price 5s.

In small space we have in a very comprehensive form set before us a large amount of astronomical knowledge. The Planisphere consists of a moveable map of the Northern Celestial Hemisphere, a South Polar map, etc. This is a very compact and valuable little work.

PHYSIOGNOMY AND EXPRESSION. By F. Mantegazza. Crown 8vo, pp. x.—318. (London: Walter Scott.) Price 3s. 6d.

This book is utterly unlike most books on the subject. It treats the matter scientifically, and discards, or seeks to discard, everything that observation and experience do not confirm. Those who desire easy and infallible rules for judging their own or other people's character will be disappointed; but those who wish to study the general indications of character given by the features will be interested in this work.

EVOLUTION AND DISEASE. By J. Bland Sutton. Crown 8vo, pp. xiii.—285. (London: Walter Scott. 1890.) Price 3s. 6d.

In this interesting volume of the "Contemporary Science Series," the author shows, by some carefully-worded examples, that there is a natural history of *disease* as well as of plants and animals. The twelve chapters into which the work is divided treat of The Enlargement of Parts from increased use; Disuse and its effects; The Transmission of Malformations and Acquired Defects; Anatomical Peculiarity of the Teeth in relation to Injury and Disease; Causes of Disease, etc. etc. There are 135 illustrations.

NATURE AND REVELATION. By the Rev. C. Pritchard, D.D., F.R.S. (London: John Murray. 1889.) Price 7s. 6d.

This book consists of 11 Sermons by a learned scientific man and a devout Christian, and will be read with interest and advantage by every enquiring mind.

Such subjects as The Continuity of the Schemes of Nature and Revelation; Aspects of Nature in relation to Miracles and Providence; Difficulties of Belief—the Miracle of the Sun Standing Still; the Star of the Magi; and the Creation, are treated in a most able and satisfactory manner, and cannot fail to give help and comfort to many who may have felt difficulties with regard to these subjects.

THE SALT CELLARS, Vol. II. By C. H. Spurgeon. Crown 8vo, pp. 367. (London: Passmore and Alabaster. 1889.)

A continuation of Rev. C. H. Spurgeon's Collection of Proverbs, together with Homely notes thereon. Vol. II. covers from M to Z, thus completing the series.

THE MAGAZINE OF POETRY: A Quarterly Review. Illustrated. Crown 4to, pp. 510. Edited and published by Charles Wells Moulton, Buffalo, N.Y. (U.S.A.) 1889.

Mr. Moulton has not only attempted, but has most creditably accomplished a grand work. In it we find between 900 and 1,000 complete poems of no mean order, and upwards of 400 quotations. To this work some 500 poets have contributed, and it is embellished with plates in every conceivable style of Mechanical printing, as Steel engravings, Photo engraving, etc., of some 60 or more very excellent portraits, besides a number of other beautiful illustrations.

THE HISTORY OF MEXICO, Vol. I. By Hubert Howe Bancroft. 8vo, pp. cxii.—702. (London: Trubner and Co. San Francisco: The History Publishing Co.)

The volume before us covers the period between the years 1516 and 1521, and presents the famous conquest of Mexico by Cortés, a feat perhaps unsurpassed in the annals of ancient or modern warfare, and which opened to the world the richest, most populous, and most civilised country on the northern continent. Some idea of the immensity of the task undertaken by the Author in writing the seven volumes into which this history is divided may be arrived at when we state that the list of works consulted in its compilation occupies no fewer than 90 pages.

YORKSHIRE LEGENDS AND TRADITIONS as told by her Ancient Chroniclers, her Poets, and Journalists. By the Rev. Thos. Parkinson, F.R.Hist.S. Second series. 8vo, pp. x.—246. (London: Elliot Stock. 1889.)

We have before us a second series of these most entertaining Legends and Traditions. They consist of those relating to Historical persons and places: to Robin Hood and his men in Yorkshire, Fairy legends and traditions, those relating to Wells, Lakes, etc., Monastic legends, Humorous legends, Legends and traditions of Witchcraft, and relating to places. A thoroughly readable book.

NEW LIGHT FROM OLD ECLIPSES. By W. M. Page. With an Introduction by Rev. Jas. H. Brooks, D.D. Crown 8vo, pp. xv.—590. St. Louis (U.S.A.): C. H. Barnes' Pub. Co. 1890. Price $2·50.

The Author tells us that owing to faulty chronology the exact date of our Lord's birth, the length of His public ministry, and date of His death have not been correctly known. With the aid of the improved solar and lunar tables given by the writer we are (he tells us) enabled to calculate all the eclipses recorded in history. On this account alone, he goes on to say this volume will be found of incalculable service, not only to the astronomer, but also to the historian, chronologer, and theologian, by enabling them to give time and date with their narratives.

THE NEW BIBLICAL DICTIONARY for Teachers and Students. 8vo, pp. viii.—1,220. (London: Elliot Stock. 1889.) Price 10s. 6d.

In this thick volume we have a compendium of information on the principal subjects referred to in the Holy Scriptures. It is throughout closely printed, and affords a vast amount of information, most useful especially to Sunday School Teachers. The introduction is written by J. F. Kitto, M.A. A good number of engravings are interspersed with the text.

TREASURY OF SACRED SONG. By F. T. Palgrave. Cr. 8vo, pp. ix.—374. (Oxford: Clarendon Press. 1889).

This is an admirable and judicious selection of some of the best pieces of religious poetry that have been published during the last four hundred years.

ASPECTS OF SCEPTICISM. By John Fordyce, M.A. Cr. 8vo, pp. viii.—270. (London: Elliot Stock.) Price 5s.

This work is written by a man who not only knows his subject, but is also most liberal and candid. The History, Causes, and various forms of Scepticism are given in a very readable and instructive manner. The writer freely admits that the lives and weak arguments of Christians have often either made Infidels, or, at least, have confirmed them in their want of Faith. He considers that the Bible rightly interpreted, and the preaching of Christ in all the beauties of His character and life, are the best correctives of every form of scepticism which is so impotent in affecting for good the moral and spiritual life of those who imbibe it.

LARGER HOPE LECTURES. By W. J. Acomb. Crown 8vo, pp. xi.—276. (London: Hamilton, Adams, and Co. Maidstone: Young and Cooper. 1889.) Price 3s. 6d.

The reader will find in this book an able, clear, and readable exposition, defence, and advocacy of a doctrine which has found many believers during recent years, namely, of the ultimate salvation of all or most who die without having known or accepted Christ as their Saviour. The Author appeals very much to the feelings and reason of his readers, but his attempted refutation of the teaching of the Bible as understood and taught by the Catholic Church from the beginning is, to our mind, unconvincing and unsatisfactory.

WHAT ARE THE CHURCHES FOR? Part I.—The Home. By the Rev. F. Ballard, M.A., F.G.S., etc. (London: Elliot Stock.) Price 6d.

Mr. Ballard takes a very broad view of the Mission of the Christian Church, and intends to publish further pamphlets bearing on the Church's duty in regard to the Nursery, the School, and the Army. Why stop there? What about Politics, the Hospital, and other domains of Philanthropy? However, it will be refreshing to hear what so vigorous and original a writer as Mr. Ballard has to say on those departments of religious activity upon which he has chosen to fix his attention.

EXAMINATION PAPERS in Algebra and Arithmetic. Compiled and edited by Rev. Isaac Warren, M.A. (Dublin: Hodges, Figgis, and Co. London: Longmans, Green, and Co. 1889.) Price 1s. 6d.

These are the questions which have been proposed to students in Trinity College, Dublin, at various examinations from 1877 to 1889, with answers and in some cases hints for solution.

GEOMETRY FOR SCHOOLS. By A. J. G. Barclay. M.A., F.R.S.E. 12mo, pp. 144. (Edinburgh: Oliver and Boyd. London: Simpkin, Marshall, and Co. 1890.) Price 1s. 3d.

This little book comprises Books I., II., and III. of Euclid, with some additions and numerous exercises. A section of Analysis and Loci has been added to the first book.

HISTORY OF CALIFORNIA, Vol. IV. By Hubert Howe Bancroft. 8vo, pp. xv.—786. (London: Trubner and Co. San Francisco: The History Publishing Co.)

The history comprised in this volume embraces the period between the years 1840 and 1845. It describes what has been called the Graham affair, or the exile of foreigners; the coming of Sutter and the settlement of the Sacramento Valley; overland immigration; the departure of the Russians; Commodore Jones' capture of Montery, etc. The Pioneer Index, which is continued from the preceding volumes, whilst giving the names of all the settlers from 1542 to 1848, relates in some cases quite a history of the person referred to.

PAWNEE: Hero Stories and Folk-Tales. By George Bird Grinnell. Crown 8vo, pp. 417. (New York: Forest & Stream Publishing Co.)

These stories are intended to teach the origin, character, and customs of the Pawnee people—a rapidly-diminishing tribe of wild Indians. The book will be of interest to those who like to study the history of tribes little known to the outside world, and of whom it will probably soon be said, "Their memory and their name is gone."

THE GOD OF THE CHILDREN. By Edward Pollard. pp. 180. (London: Elliot Stock. 1889.)

This book will be prized by mothers and others who have to instruct children in the truths of religion. There are 25 Sunday evening lectures, which will interest and instruct children. Lessons are derived from the heavens, the birds of the air, and animals, and they are given in a most interesting style. There are numerous illustrations.

RECORDS OF THE PAST; being English Translations of the Ancient Monuments of Egypt and Western Asia. Edited by A. H. Sayce. Crown 8vo, pp. viii.—208. (London: S. Bagster and Sons.)

These records possess an interest for the antiquarian and historian, but especially for the Biblical student, as illustrating and in some instances confirming the statements of the sacred volume.

IN CLOVER AND HEATHER. By Wallace Bruce. Crown 8vo, pp. 198. (Edinburgh and London: W. Blackwood and Sons.) Price 4s. 6d.

This book consists of 52 poetical pieces by an American, but one who, if he is not, as his name would suggest, of Scottish origin, has intense sympathy and admiration for Burns and Scott, two of Scotland's greatest poets. Mr. Bruce stands high as a poet in the estimation of such competent American judges as Longfellow, Whittier, and Wendell-Holmes, and we think that this book will create or confirm a favourable opinion of the poetic powers of the writer among English readers.

STUDIES IN PEDAGOGY. By Gen. T. J. Morgan, A.M., D.D. Crown 8vo, pp. 360. (Boston, U.S.A.: Silver Burdett and Co. 1890.) Price $1.75.

This is a work from the pen of one who has had long experience in teaching, and who has a just and high appreciation of the office of the schoolmaster. Though it is a well-worn subject, yet the writer treats it in a somewhat novel style, and has produced a book suggestive, helpful, and readable.

THE HISTORY OF UTAH. By Hubert Howe Bancroft. 8vo. pp. xlvii.—808. (London: Trubner & Co. San Francisco: The History Publishing Co. 1889.)

We have before us one of the most interesting volumes of this magnificent series. It commences with an account of the discoveries of the Spaniards in these regions and the advent of trappers and travellers. Commencing in chapter 3, the story of Mormonism is told, with all its attendant revelations, miracles, and persecutions, how Joseph Smith had a vision, how he found the book of Mormon, began to preach, and was driven forth and killed in Illinois, his followers meanwhile fleeing to the valley of the Great Salt Lake.

TALES OF ADVENTURE, Mystery, and Imagination. By Edgar Allan Poe. Crown 8vo. pp. viii.—557. (London: Ward, Lock, and Co. 1890.) Price 2s.

This book contains 42 tales by a well-known clever author. Most of the adventures are such as would produce fear in the stoutest heart, and the lover of the marvellous and mysterious will find a feast in the 557 pages of this cheap volume.

The Life and Correspondence of Thomas Arnold, D.D. By Arthur Penrhyn Stanley, D.D. Crown 8vo, pp. xxiv.—548. (London: Ward, Lock, and Co.)

This is one of the well-known "Minerva Library of Famous Books." It is nicely bound and illustrated with a portrait and several plates. We cannot speak too highly in praise of this series of works.

Vitus Bering, the Discoverer of Bering Strait. By Peter Lauridsen. Post 8vo, pp. xvi.—223. (Chicago: S. C. Griggs & Co. 1889.)

We have here an account of Russian Explorations between the years 1725 and 1743; of Bering's birth and parentage; the founding of the Russian Navy; the desire of Peter the Great to know the extent of his empire; and of Bering's discoveries and finally his death. The book will well repay careful reading.

A History of Felsted School, with some Account of the Founder and his Descendants. By John Sargeaunt, M.A. Crown 8vo, pp. viii.—129. (Chelmsford: E. Durrant. London: Simpkin, Marshall, and Co. 1889.)

We have an interesting account of this old and still flourishing school. The various chapters treat of the Chronicles of the School; the Worthies of Felsted; the Records of the Foundation; the House of Rich (the founder); with a Table showing the descent of the Barony of Rich of Little Leez, etc. We think it a pity that the full text of the original deeds has not been given, for even at the present day there are certain Bereans who would like to search the writings. The book contains good views of the old and the present school buildings and of Leez Priory.

The Medical Annual and Practitioners' Index. Crown 8vo, pp. xlviii.—656. (Bristol: J. Wright and Co. London: Simpkin, Marshall, and Co. 1890.)

This important Annual is now in its eighth year. Part I., devoted to Therapeutics, covers 100 pages; Part II., New Treatment, 430 pp.; Part III. treats of Sanitary Science; followed by the Lunacy Act Amendment Bill, New Inventions and Progress of Pharmacy, Books for the Year, etc.

Each succeeding year sees a marked improvement in this Annual.

Atlas of Commercial Geography. By John George Bartholomew. Royal 4to. (London: C. J. Clay & Sons, Cambridge University Press Warehouse. 1889.) Price 3s.

This atlas consists of 27 most useful maps, in which prominence is given to those physical conditions of the earth which directly affect commerce and the distribution of commodities. They show Height of Land and Depth of Sea; Mean Annual Rainfall, with Limits of Snowfall; Prevailing Winds; Temperature; Distribution of Mineral, Vegetable, and Animal Commodities; Animals of Importance to Commerce; Population; Leading Races of Men and of Religions, etc. To these are added a number of Special Maps, showing Political Features, Railways, etc. The maps are coloured and well executed.

The Federal Government of Switzerland. By Bernard Moses, Ph.D. Crown 8vo, pp. 256. (Oakland, California: Pacific Press Pub. Co. 1889.) Price $1.50.

An interesting history of Switzerland is before us. It treats of the Antecedents of Swiss Federalism, Distribution of Power, the Legislature, Executive, Judiciary, Foreign and Internal Relations, and Common Prosperity. It is a thoroughly readable book.

The Sunday School Manual. By John Palmer. 18mo, pp. 422. (London: Church of England S.S. Institute.) In Four Parts. Price 2s. 6d. or 8d. each Part.

A very useful work for the Sunday-School teacher. It is divided into two sections:—1.—The History and Management of Sunday Schools; 2.—The Teacher's Work. In the first section ten subjects are treated of, and nine in the second. We feel that we can cordially recommend this work.

Young People's Birthday Text-book. 16mo, pp. 124. (London: Wesleyan Methodist S.S. Union.) Price 1s. 6d.

A very prettily got up book. It is arranged with three dates to a page; a text and verse of a hymn being given for each day.

Temperance History. By Dawson Burns, D.D. Part II. 8vo, pp. from 225 to 462. (London: Nat. Temperance Publication Depôt. 1890.) Price 2s.

This second part of the History of Temperance gives us in a consecutive narrative the rise, development, and extension of the Temperance reform from the years 1843 to 1861, and commences with an account of the Irish Temperance reform, Father Mathew's visit to England, the Scottish Temperance League, etc.

1,000 Answers to 1,000 Questions. (London: *Tit-Bits* Office. 1890.) Price 1s. 6d.

We have here a reprint of the fourth series of 1,000 Questions answered in the *Tit-Bits* enquiry column. In many cases these answers impart a large amount of useful information.

Humorous Readings in the Norfolk Dialect. By the Author of Giles's Trip to London. 2 Vols. (London: Jarrold and Sons.) Price 1s. each.

These two volumes contain 9 very humorous and witty sketches. Those readers who have any knowledge of the dialect spoken by the rustics of Norfolk will derive a large amount of amusement from them.

The Art of Retouching Photographic Negatives, and Clear Directions how to Finish and Colour Photographs. By Rob. Johnson. 8vo, pp. iv.—131. (London: Marion and Co., Soho Square.) 1889.

The instructions given in this book are sure to assist the photographer, whether amateur or professional. They treat of retouching in every conceivable manner in which such is required. The book is illustrated with a number of well executed litho plates. It is a valuable work.

The American Annual of Photography for 1889 and 1890. (New York: The Scoville and Adams Co.) Price 50c. each.

Few books reach us which contain information more useful to the photographer than do the Photo. Times Almanacks. These each consist of about 330 pages, and contain together about 36 full-size plates, mostly fine specimens of the various systems of Photo Engraving.

Pictorial Effect in Photography. By H. P. Robinson. 8vo, pp. viii.—158. (New York: The Scoville and Adams Co. 1889.) Price $1.50.

In this volume we have Hints on Composition and Chiaro-obscuro for

Photographers. The object of the author is to make the photographer an artist, and to convince him that manipulation is not the chief and only essential to making a good photograph. It is to counteract the erroneous idea that art and photography cannot be combined that this book was written.

PROCESSES OF PURE PHOTOGRAPHY. By W. K. Burton and Andrew Pringle. 8vo, pp. ix.—200. (New York: The Scoville-Adams Co. 1889.) Price $2.

This work appears to give an exhaustive review of the various processes employed in photography, and the authors, who are well-known practical men, assure us that every word they have written refers to subjects with which they are personally and intimately acquainted. Every formula has been used by one or other of them.

A DICTIONARY OF PHOTOGRAPHY, for the Professional and Amateur Photographer. By E. J. Wall. 8vo, pp. 237. (New York: The Scoville and Adams Pub. Co. 1889.)

This most useful work is, if we mistake not, a reprint of an English edition published some time during last year. It contains a number of valuable and explanatory articles, several of them illustrated by diagrams.

PHOTOGRAPHIC MOSAICS: An Annual Record of Photographic Progress. Post 8vo, pp. viii.—150. (New York: Edward Wilson. 1890.)

In this edition of the "Mosaics," the publishers have packed together, in small compass, a large number of very useful hints on almost every subject of interest to the photographer. It contains also several good specimens of photo-mechanical printing.

THE YEAR-BOOK OF PHOTOGRAPHY and Photographic News Almanac for 1890. (London: Piper and Carter.) Price 1s.

Contains the results of Photographic Experimenting throughout the year and a large number of special contributions by leading photographic authorities, both professional and other. These notes extend over more than 200 pp. and will be found to contain many valuable hints.

THE BRITISH JOURNAL Photographic Almanac, 1890. (London: H. Greenwood and Co.) Price 1s.

A thick volume of nearly 1,000 pages, more than 300 of which are filled with useful hints and papers of much value to the photographer. These papers embrace a great variety of subjects, contributed by upwards of 170 contributors.

TAYLOR'S PRACTICAL HINTS and Photographic Calendar, 1890. (Birmingham: W. Tylar.)

This is a trade catalogue, in which is incorporated many Practical Hints, Cullings, and Witty Sayings. It is not a bad four-pennyworth.

TRAITE DE PHOTOGRAPHIE par les Procédés Pelliculaires. Par George Balagny. 2 Vols. Royal 8vo, pp. vii.—132, 138. (Paris: Gauthier-Villars et Fils. 1890.)

In this treatise on the various forms of what may be termed film photography, the author has given us a description of all the various processes other than those in which glass plates form the medium over which the sensitive coating is distributed. We are somewhat disappointed at not finding any mention of the introduction of celluloid as the supporting medium. The reader will find a very interesting chapter on "La Photographie sans pied," pointing out the necessary conditions for the successful practice of what we should call "hand photography."

LE TEMPS DE POSE. Par A. de la Baume Pluvinel. Crown 8vo, pp. viii.—121. (Paris: Gauthier-Villars et Fils. 1890.)

This is an elaborate mathematical treatise on the theory and practice of the exposure of the sensitive medium—too elaborate, we fear, for the general run of operators. We are sadly too apt to go by rule of thumb and to regulate the time of an exposure by our estimate of the photographic value of the light and the known power of the lenses we are working with. But if we go with Mons. Pluvinel we shall require a thorough mathematical education. We have no doubt that the conclusions arrived at are sound, but the method of arriving at them seems circuitous.

LA PHOTOGRAPHIE a la Lumière. Par Le Dr. J. M. Eder. Crown 8vo, pp. vi.—63. (Paris: Gauthier-Villars et Fils. 1890.)

The process of obtaining good results by means of the magnesium light is well set forth in this little treatise, and the various forms of magnesium lamps, with their several advantages and disadvantages, are well described and illustrated by a series of very good and clear diagrams.

GREAT THOUGHTS. (London: A. H. Hall, 132 Fleet St.)

This magazine is published in weekly numbers and in monthly parts. The parts dated February and March are now before us. They contains extracts from the best writers of all ages, Portraits and Memoirs of celebrated personages of our own and earlier times, a story of much interest by Dr. Joseph Parker, Poetry, etc. etc.

RESEARCH. Edited by A. Norman Tate, F.I.C., F.C.S., F.G.S., F.R.M.S., etc. (London: E. W. Allen.) Monthly, price 3d. Is a monthly illustrated Journal of Science.

One of the chief features of this Journal is the monthly publication of the portrait of one of our eminent Scientists. The March number contains that of Prof. John W. Judd, F.R.S., F.G.S., etc. Other papers of interest are: Physics of the Earth's Crust, Vaucheria and a Parasitic Rotiferon, The Evolution of Man, Scientific Research in Yorkshire, Dust in the Air, and many others. One of the engravings exhibits a Russian giantess, a young lady of only 12 years of age, who has already attained the height of six feet eight inches, a height which she promises considerably to exceed.

LIFE LORE. Edited and published by W. Mawer, Essex Street, Strand. Price 4d. monthly.

In every sense a magazine of Natural History. Its articles are well written, and the illustrations are many and good. In February was commenced "A Course of Vegetable Physiology." A series of interesting papers addressed to young people is a special feature of this magazine.

KNOWLEDGE. Edited by A. Cowyer Ranyard. Published by W. H. Allen and Co. 6d. monthly.

An illustrated magazine of Science, simply worded, and exactly described; affords a large amount of useful and valuable information monthly.

ILLUSTRATIONS. Conducted by Francis Geo. Heath. (Office: 1 St. Swithin's Lane.) Price 3d. monthly.—This is a magazine of Amusement: Art, Biography, Economy, Invention, Literature, and Science. We can confidently recommend "Illustrations" to our readers.

A Handbook of Scientific and Bible Difficulties. Edited by Rev. Robert Tuck, B.A. (London: Elliot Stock.)

A very useful book, containing facts and suggestions for the solution of perplexing things in sacred Scripture. Considerable light is thrown on many difficult passages. This is a monthly work, price 6d.

The Field Club: A Magazine of General Natural History for Scientific and Unscientific Readers. Edited by Rev. Theodore Wood. (London: Elliot Stock.) Monthly, price 3d.

We are pleased to notice this new magazine. It contains a number of interesting and well-written papers. We wish it every success.

Springtide.—This is a monthly illustrated magazine, suitable for boys and girls, published by Mr. E. Stock at 1d.

The Antiquary. (London: E. Stock.)—A monthly magazine, devoted to the study of the past. It contains a series of papers of much interest to the antiquary. This important work has now entered on its 21st volume. The present volume commences a new series. It is published at 1s. a month.

History of the Fish St. Congregational Church, Hull. By W. G. B. Page. (Hull: 77 Spring Street. 1889.)

Mr. Page is Sub-Librarian of the Hull Subscription Library. He has given a brief history of the origin and progress of Independency in Hull and the later secession which led to the foundation of a church in Blanket Row, which was subsequently transferred to Fish Street.

British Fossils and Where to Seek Them. By Joseph W. Williams. Crown 8vo, pp. 96. (London: Swan Sonnenschien and Co. 1890.) Price 1s.

We have pleasure in noticing another volume of the "Young Collector Series." Besides treating of the Life of the Primary, Secondary, Tertiary, and Post-Tertiary epochs, instructions are given for collecting Fossils and arranging them in the cabinet; List of Books likely to be of service to the student; and a Glossary of Palæontological Terms. The book is nicely illustrated. Young collectors would do well to secure the entire series. They form a valuable library in themselves.

Chronic Bronchitis and its Treatment: A Clinical Study. By William Murrell, M.D., F.R.C.P., etc. Crown 8vo, pp. 176. (London: W. K. Lewis. 1889.)

The work before us is a record of Clinical work extending over a period of about ten years, and the notes from which it has been compiled have been taken, for the most part, either at the bedside or in the out-patient's room. It contains a large amount of information, which, on careful study, we hope may prove personally very beneficial.

Hone's Table Book and Year Book.

Messrs. Ward and Lock are publishing in monthly parts, at sixpence, a reprint of this famous old book of daily recreation and amusement concerning Remarkable men and manners, Times and Seasons, Solemnities and Merry-makings, Antiquities and Novelties, forming a complete history of the year, and key to the Almanack. The old illustrations are faithfully reproduced.

THE ENGLISH LANGUAGE: Its Sources, Growth, History, and Literature. Post 8vo, pp. 130. (London: Moffatt and Page.) Price 1s. 6d.

The seventeenth edition of this little work is now before us. It treats of the Origin of the English language, the elements of which it is composed; Prefixes and Affixes; Words of Old English Origin, of Anglo-Saxon, Latin, and Greek derivations, etc., etc. Much useful information is given in small compass.

We have also received the following:—

IN THE FAR EAST. Letters from Geraldine Guinness in China. Edited by her sister. Crown 4to, pp. 192. (London: Morgan and Scott.) Price 3s.

FARMER READ'S KINGDOM: The Story of One Poplar Farm. By Charles R. Parsons. Crown 8vo, pp. 167. (Stirling: Drummond's Tract Depôt. London: S. W. Partridge and Co.) Price 1s. 6d.

This is a good tale, perhaps one of the best we have read. It is written in a style which cannot fail to interest the reader, and is nicely illustrated.

MAKING THE BEST OF IT. By Rev. Edward A. Rand. Crown 8vo, pp. 281. (New York: Thomas Whittaker. 1888.) Price $1.25.

A capital volume of the "Look-a-head" series.

THE JOLLY HARPER MAN, and other tales.

AS GOOD AS GOLD. By Wilhelm Herchenbach.

CHASED BY WOLVES, and other stories. (Dublin: W. M. Gill and Son.) 1890.

Three books containing a number of interesting tales.

ERIC'S HYMN, and other Stories. By Edith Greeves.

TATTERS, and Jennie's School-days. By Lillie Pethybridge.

ELISE FONTAINE. By Alice Briggs. pp. 80. (London: Wesleyan Methodist S.S. Union.) Price 1s.

Interesting religious tales, well suited for a Sunday School Library.

TALES OF TERROR AND WONDER. Collected by Matthew Gregory Lewis. Crown 8vo, pp. 283. (London: Routledge and Sons.) Price 1s.

TRAVEL, ADVENTURE, AND SPORT, Nos. 5 and 6.

TALES FROM BLACKWOOD, Nos. 6 and 7. (Edinburgh and London: Blackwood and Sons.)

DRAUGHTS AND BACKGAMMON. By Berkeley. 12mo, pp. 128. (London: George Bell and Sons. 1890.) Price 1s.

HORNER'S PENNY STORIES FOR THE PEOPLE.

These stories are well written and are calculated to do much good.

Bacteria:
A Practical Study in Biology.

Definition.

BIOLOGY is the science of living things :—βιος—life, λογος—science. It may be divided into two branches, each of which corresponds to a distinctive mark of living things. They may be recognised —(1) By their form—Morphology ; (2) by their effects (movements and mutual actions, chemical)—Physiology. The simplest possible organism is *Torula*, the single cell of *Saccharomyces*, or Yeast. There is no well-defined limit between ferments and fungi, or, again, between fungi and bacteria. Their smaller size is the principal difference which separates bacteria from ferments, since in other respects these two classes are for the most part alike in form and organisation. Everyone now speaks of microbes, yet few of those who make use of the term have any clear conception of the organisms in question, or could give an exact account of the function which microbes fulfil in nature. And yet this function concerns us all. There is much to be done before modern society is practically on a level with the achievements of science; many prejudices must be uprooted and many false notions must be replaced by those which are sounder and more just.

In order to indicate the organisms which produce diseases, the English and Germans use the word BACTERIA, which is only the name of one of the peculiar species assigned to this group, and the one with which we have been longest acquainted. In this case the name is generalised and applied to the entire group. The Italian authors who have been recently occupied with the study of microbes have on their part adopted the name PROTISTA, proposed by Haeckel, and of which the sense, although not the etymology, is almost the same as that of the word *Microbe*, which is the French term for Bacteria, and only signifies a small living being. It decides nothing as to the animal or vegetable nature of the organisms in question. Béchamp terms microbes *microzyma*, or small ferments, since the chemical reactions which result from their vital activity are generally ferments. Bacteria are distinguished from animal cells by being able to derive their nitrogen from ammonia compounds, and they differ from the higher vegetable cells in being unable to split up carbonic acid into its elements, owing to the absence of chlorophyll.

The Schizomycetes, or "splitting-fungi,"—German, *Spaltpilze*—(*σκιζω—I split, μυκος—fungus*) *are unicellular plants, which multiply by repeated subdivisions in one, two, or three dimensions of space, and also frequently reproduce themselves by spores, which are formed endogenously. They live, either isolated or combined in various ways, in fluids and in living or dead organisms, in which they produce decompositions and fermentations, but never alcoholic fermentation.*

I shall use here the method I gave in my paper on *Amœbæ* in the *American Monthly Microscopical Journal* for July, 1889, which may be altered to suit requirements :—(*a*) Structure, (*b*) digestion, (*c*) absorption, (*d*) circulation, (*e*) respiration, (*f*) secretion, (*g*) nervous system, (*h*) sense-organs, (*i*) motor organs, (*k*) reproduction, (*l*) development, (*m*) classification.

Practical Work.

Every plant or animal must be seen, examined, dissected, and drawn.

(*a*) **Structure.**

1.—*Occurrence.* Wherever there is putrefaction they are present in vast numbers : in water, in soil, in sewage, in the intestines, and in uncleanly persons—especially on the skin and between the teeth—various species may be found. The red colour noticed in mouldy bread is due to Bacteria. Such diseases as diphtheria, typhus fever, consumption, cholera, anthrax (or "wool-sorters' disease"), appear to depend on their presence.

Many cases of fermentation are due to the presence of these organisms, and the putrefaction of plants and animals seems to result from fermentations originated by them. Students who may wish to prepare these organisms without the help of disease will find it best to infuse hay in warm water for thirty minutes; filter, and keep the filtrate in a warm place. Note the changes which go on in it. At first clear; in 24—36 hours it becomes turbid; later on, a scum forms on the surface, and the infusion acquires a putrefactive odour. One very common bacterium may be easily procured—*Bacterium termo*, Dujardin ("Zoophyt," p. 212); (synonyms, *Monas termo*, Müller; ? *Palmella Infusionum*, Ehrenberg; *Zooglœa termo*, by Cohn)—by taking half-a-glass of ordinary water from a spring or river, and leave it for some days on a table or chimney-piece, the vessel being uncovered to allow free access of air. The water from the top of a small aquarium will also show them, or a small piece of meat kept in water at a moderate temperature.

2.—*Size.* They are very minute. Hence arises a great danger of the confusion of other bodies with these on the part of the student. The cells are shortly cylindrical, oblong, about 1·5—2 μ long, with a flagellum at each end.

3.—*General Structure.* They are masses of protoplasm of various shapes, that are in many cases not surrounded by a distinct wall. Protoplasm is derived from πρωτος—first, πλασμα—formative matter; *i.e.*, matter that can be shaped into other substances, such as the tissues of a plant or of an animal body. It is semi-fluid, granular in appearance, and consists of four elements—carbon, hydrogen, oxygen, and nitrogen. It has the power of contractility. The protoplasm adheres to iodine, and it becomes brown. If the piece of protoplasm is without an enveloping wall, as in many Bacteria, and consists of protoplasm, and protoplasm only, we have a *plastid.* If the protoplasm is invested with a distinct wall—that is, wholly distinct of structure—the being is a *cytode;* for a cytode is a free mass of protoplasm enveloped by a distinct wall. This wall is more transparent than the contents. In the compound form it is only to be seen just where the joints making up the compound form come in contact one with the other. In the still condition of these organisms the wall is exceedingly gelatinous. This still stage, with its thick envelope of jelly-like material, is known as the *zooglœa* stage (Ζωον—life; γλοιος—viscid).

4.—*Different forms* of Bacteria are classed under this heading. When they occur alone, they may be either spherical, as in certain forms of Micrococcus, or rod-like, as in the true *Bacteria*. When they occur aggregated together, they may be of the form of rudimentary cells, as in other varieties of micrococcus, or as rod-like structures joined together. Even this last arrangement admits of sub-division, as rod-like parts may be conjoined end on end, or at an angle (not of 180°), or wound in a spiral. The following table may make this clear :—

BACTERIA.	Isolated	Spherical—*e.g.*, Micrococcus.	
		Rod-like—*e.g.*, Bacterium.	
	United	Spherical—*e.g.*, Micrococcus.	
		Rod-like	Parts joined end on end *e.g.*, Bacillus.
			,, ,, at an angle—*e.g.*, Vibrio.
			,, ,, spirally (often a double spiral) *e.g.*, Spirillum and Spirochæte.

5.—*Effects of Re-agents and Temperature.*

(α) Iodine stains all formative matter or protoplasm brown, and occurs with all formative matter, ready to be, but not yet actually transformed into a plant or animal substance. The outer wall does not stain.

(β) Magenta or carmine solution also stains protoplasm.

(γ) A temperature of 0° C. (32 F.) and of 60° C. (140° F.) kills them. These are their limits of temperature. They thrive best at 30 C.° (86° F.).

(δ) Dessication. They can survive a lengthy period of drying or dessication, and on adding moisture they revive.

(*b*) **Digestion.**—Bacteria feed on decaying organic matter. Hence their name of *Saprophytes* (σαπρος—putrid, φυτον—plant). Pasteur's fluid causes them to thrive. This food is taken in by the whole of the general surface. There is no definite mouth or digestive apparatus.

(*c*) **Absorption.**—As in many of the lower living beings, the function of absorption is merged with that of digestion. The whole surface of the Bacteria absorbs food. But that very absorption is here in reality a digestive process, and results in the in-taking of food.

(*d*) **Circulation.**—Nothing to be noted.

(*e*) **Respiration.**—The organs of respiration are on the whole body surface. The lower we descend in our study of Biology the more do we find every function performed indifferently by every part. Nothing is specialised. The whole body breathes, reproduces.

(*f*) **Secretion.**
(*g*) **Nervous System.**
(*h*) **Sense-Organs.**
There is nothing to be studied under these heads.

(*i*) **Motor Organs.**—I would here warn the student against a movement noticeable in these organisms that he will be apt to regard as due to life. It is highly important not to confound the two kinds of motion. That of dead matter is merely mechanical, not vital, and resembles somewhat the swinging motion of a pendulum, or that of "a floating buoy round its mooring." This movement can be seen whenever any very small particles of matter, living or dead, are suspended in a liquid. Very finely-divided charcoal, camphor, cinnabar, or gamboge, if placed in water, will exhibit similar movements. It is called the *Brownian movement*, after Brown, who thoroughly investigated it. It is simply a molecular movement, due to mechanical, not to vital causes. Some of the Bacteria only show this motion, and are then said to be in the still stage. As in this condition they are usually surrounded by a quantity of jelly-like material, this stage is known as the *zooglœa* stage. Very often these organisms are in an actively mobile condition, and undergo movements of translation from place to place. The cause of these movements is in most cases not known. It is possible they may result from the general contractility of the protoplasm. But in *Spirillum volutans*, at each end a cilium or long, fine, hair-like process has been seen, and by the movement of the cilium that of the Spirillum as a whole is effected. *Vibrio* has a wriggling motion, which is really due to its having a zigzag arrangement of its joints, and also a rotation upon its own axis. *Bacillus* is always free-swimming.

(*k*) **Reproduction.**—This in living things is either asexual or sexual. The former is called *agamogenesis* (*a*—without, γαμος—marriage, γενεσις—reproduction). The latter, *gamogenesis*. Only the asexual or agamogenetic is known in connection with those low forms of living things. The particular method encountered here is division or technically, *fission* (findo—I split). Certain divisions of the Bacterium undergo transverse division. A cytode is divided into two by an ingrowth of its wall, and the cytodes thus formed last a longer time, and can resist injurious agencies more effectually than their fellows. By such division a Bacterium becomes two Bacteria. Bacillus also produces spores—*e.g.*, rounded structures that are thrown off from the parent and developed into a new being.

(*l*) **Development.**—Nothing can be said here, as the new individual is of the same nature as the parent.

(*m*) **Classification.**—Cohn classifies the Bacteria according to their form into *Sphærobacteria* (globular cells), *Microbacteria* (minute, rod-like cells, Bacteria proper), *Desmobacteria* (larger rod-like or filiform cells, Filobacteria), and *Spirobacteria* (twisted or spiral cells). The student should rigidly adhere to order in this. For our convenience we divide everything in the universe as mineral, animal and vegetable. We regard each kingdom as divided into sub-kingdoms. These again, contain classes. Each class is made up of orders. An order has genera (genus—kind). A genus consists of species. Hence in classifying Bacteria, we say its food is inorganic, therefore it belongs to the kingdom *Vegetabilia*. It is a flowerless plant, without stamens and carpels; therefore, it belongs to the sub-kingdom *Cryptogamia* (κρυπτος—hidden, γαμος—marriage). There is no distinction of axis and appendages, as in the stem and leaves of a tree; therefore, it is of the group *Thallophyta* (θαλλος—a sprout, φυτον—a plant). It is without green colouring matter, chlorophyll; therefore of the class Fungi. Gamogenesis unknown, fission the only form of agamogenesis; therefore, of the order *Schizomycetes* (σχιζω—I split, μυκος—fungus). Genus, *Bacterium*, *Vibrio*, or *Bacillus*, etc.

For the **Chemical Composition** of Bacteria, we are indebted to Nencki. Their constituents vary slightly according as to whether the bacteria are in zooglœa, or in the active state. In 100 parts of the dried constituents, there are the following :—

A nitrogenous body 84·20, Fat 6·04, Ash 4·72, undetermined substances 5·04. This nitrogenous body is Mycoprotein, so-called, and consists of Carbon 52·32, Hydrogen 7·55, Nitrogen 14·75, but no sulphur or phosphorus. The nitrogenous body appears to vary with the species, for in *Bacillus anthracis* a substance has been obtained which does not give the reactions of mycoprotein, and, therefore, is distinguished as anthrax-protein. Bacteria can and do utilise the last traces of energy in urea. It is the Bacteria which play the most important part in disease, exciting both general and systemic affections. The others—*e.g.*, *Blastomycetes* (yeasts), and *Hyphomycetes* (moulds)–exert a merely local influence. The animal parasites become dangerous in virtue of their size, or multitude, or by penetrating into vital organs. Special reagents or staining processes have to be employed to discover them ; sometimes certainty is only reached by experimental cultivation of the products of disintegration of the tissue in question.

Reagents.—Water is essential for their growth, though deprivation does not kill all the bacteria. Different species grow best on different nutrient media.

Effect of Temperature.—Here again they vary, many grow best at the temperature of the blood, and hence the value of agar-agar media, which is not liquefied at 37° C. (or 98·60 F.) The *B. tuberculosis* will only grow at a temperature varying between 30° C. (= 86 F.) and 41° C. (= 109° F.).

Cold.—The Bacteria seem to have a special power of resisting cold ; even comma bacilli, if exposed to a temperature of —10° for an hour, and bacilli of anthrax after exposure to a temperature — 110° C., still retain their vitality. The spores retain their vitality after immersion in boiling water, but are destroyed by prolonged boiling.

Movement prevents their growth.

Gases.—Hydrogen and carbonic acid are believed to stop movement of the motile bacteria. Chloroform is believed to arrest the changes brought about by the zymogenetic species.

Electricity.—Cohn and Mendelssohn found that a constant galvanic current produced a deleterious effect owing to electrolysis.

Light.—Sunlight is fatal to putrefactive bacteria.

Carbonic Acid.—A 5% will kill the spores of *B. anthracis* in 24 hours. 3% will not do so in the same time. A 1% kills the bacilli.

Chloride of Zinc in 5% has no effect on anthrax spores, even when they have lain in it for a month.

Sulphurous Acid is not a good disinfectant, and will not penetrate compact masses or bundles.

Corrosive Sublimate has the most powerful effect on the organisms, an aqueous solution of 1 : 20,000 kills the spores of bacilli in 10 minutes. A solution of 1 : 5,000 is thus a certain disinfectant.

Iodine, Bromine, and Chlorine, are far more active than sulphurous acid. Bacilli cease to grow in Iodine of 1 : 5,000, and of Bromine of 1 : 1,500.

The Oils of Thymol, cloves, peppermint, mustard, turpentine, eucalyptus, all restrain their development; the latter being very good, and is especially useful in Dental cases to prevent bacterial growth in the teeth, as it penetrates the tubules. ALL DISINFECTING REAGENTS SHOULD BE USED IN AQUEOUS SOLUTIONS.

PRACTICAL WORK.

(1) Observe Brownian movement in gamboge, etc., suspended in water.

(2) Turbid hay infusion under high power.

(3) Stain the various organisms.

(4) Stain with magenta.

(5) Observe cilia in *Spirillum*.

To Stain the Bacteria.—The following methods are useful for all Bacteria, Micrococci, and Bacilli, except those of Tubercle and Leprosy:—Dry a film of fluid containing the Bacteria on a cover-glass, pour a little staining solution into a watch-glass, and place the cover on it, with the *dried material downwards*, leave for from 5—60 minutes. The time can only be learnt by practice, as the materials differ. When thoroughly stained, wash the cover-glass in methylated or rectified spirits until all the superfluous colour is removed, taking care that it is not washed *too* much, or the Bacteria film washed off. Then dry the cover-glass by holding it on its edge on blotting-paper, allow to dry. Then mount in Canada Balsam.

To Stain Sections of Tissue containing Bacteria.—Place them in the stains given below and leave for some hours. When deeply stained, wash in water to remove excess of stain, then lay them out flat in spirit and leave till no more colour comes away. Transfer to absolute alcohol which fixes the colour, then to clove oil, and mount in Canada Balsam.

The best stains are Gentian Violet, Spiller's Purple, and Methyl Blue, the great difficulty being to obtain good samples of the dye, as the manufacturers change the numbers often, and the anilins differ greatly.

Gentian Violet, 2%.—Take 2 grms. of the powder, rub it up in a mortar with 10 c.c. alcohol (sp. gr., 0·830), some prefer that in which 2 c.c. of anilin oil has been dissolved. Then add gradually 90 c.c. of distilled water while stirring.

Spiller's Purple.—Make as above, using the same strength.

Methyl Blue.—A 2% solution in distilled water and a little alcohol added whilst triturating the powder, *previous* to the water being added. (A little Liq. Potassæ, 1 c.c., may be added in preference to alcohol, if desired.)

Gram's method, with a saturated alcoholic solution of gentian violet and anilin water and iodide of potassium, is good.

For Bacilli in Sputum and Tissue.—The methods are very numerous, but I prefer Gibbes' Double-Stain or his Magenta and Nitric Acid Methods, as they are always to be relied on if the dyes are pure and take very little time. I have seen and prepared specimens of sputa in five minutes for diagnostic purposes. The Bacilli do not fade.

The Ziehl-Nielsen method and Sulphuric Acid is also very similar to the above Magenta, but I think the Magenta is to be preferred. All the other methods can be found in the various journals and tried by those who wish to experiment; but the two stains given are all that are required by the student and busy practitioner.

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THE NEW APOCHROMATIC LENS.—In our last issue it was stated that the price of this lens was £40. Dr. Pelletan had described it as costing 10,000 francs, but it was announced at a recent meeting of the Royal Microscopical Society that Dr. Pelletan had intended to write 1,000 francs.

Our British Plants

By F. T. Law, F.R.M.S.

Plate XI.

IN his rambles through different parts of the kingdom in search of wild flowers, the observant botanist, e'en though he be a novice in his science, and not deeply read in the profuse botanic lore of these later times, cannot fail to remark, not only the diversities in genera and species of plants found in different localities and upon varying soils, but the peculiarly distinct types of plants which are seen in the lowlands and upon the higher hills of our country; and the variation from these again in those small groups which, if it be his good fortune to visit the south-western counties of England, and of Ireland, he will find in those districts.

Although it is now about forty-five years since the late Professor E. Forbes drew the attention of the scientific world to these interesting facts, and fifteen since the Rev. Hugh Macmillan, in his delightful "Holidays in the High-Lands" appealed to a wider and more general class of readers, we believe that comparatively few are acquainted with the attractive subject. Little more than an outline can be given in this paper. For fuller details reference should be made to the Rev. H. Macmillan's book.

Four well-marked groups of plants are to be found in the British Isles, all of them having their origin in other lands. Indeed, it has been said that among the fauna and flora of Great Britain only two forms—the Common Red Grouse, and *Neottia gemmipera*, an orchid growing in the south of Ireland—are peculiar to the islands.

The great majority of our plants—those of the lowlands, variable as they appear when growing upon the chalk, the clay-lands, or upon limestone; whether they seem to be little akin as they are found in our meadows, by our streams, in the woods, or upon the lower ranges of hills—have all a common origin. They are identical with forms abundant in central and western Europe, and have been named "Germanic plants." Yet, in Java, the *Southernwood* and *Ribwort Plantain*, two of the commonest of these plants, are found on one of the mountains at the height of 9,000 feet, and on the higher parts of the Himalayas and the mountains of central India many other European genera are found. It was the opinion of Dr. Darwin that these north temperate plants migrated during the great Glacial epoch. There is little doubt that the British representatives crossed what is now the North Sea when this country was united to the continent.

In the southern and south-western counties of England is found a group of plants, found nowhere else in the country, and which, having close relationship to the flora of the north-west of France and the Channel Islands, has been styled the "French type." Examples of this type are *Trifolium strictum* and *Hypericum linariifolium*, both found in Cornwall and Jersey.

In the mountainous region of the south-west of Ireland are a few hardy species of plants quite distinct from the French or the Germanic type, and, strangely, are identical with species found in Spain and Portugal; nowhere else in northern Europe are they to be found. Six species of Saxifrage; three species of heather, the most remarkable of which is the beautiful *St. Daboec's Heath;* the *Strawberry tree* (*Arbutus unedo*), the only representative, by the way, of the Heath tribe to be found in Palestine; the *Spanish Butter-wort;* and the *Pyrenean Cress* are among the most interesting plants of this group. As none of these forms are to be found in France it is improbable that they could have come to us by that route, and no existing oceanic currents could have aided the distribution. It must have been that Spain and Ireland were once united, and if the migration were from the southern country it must have been across what is now the Bay of Biscay. Or, was the migration from some western land to both these countries simultaneously? Geologic science aids in the solution of the mystery. During the Miocene epoch a great continent appears to have extended westward from Europe; Madeira, the Azores, and the Canaries, the highlands of this continent, are now the sole relics. "The semicircular belt of gulf-weed, called the Sargassum Sea, ranging between the 15th and 45th degrees of north latitude, remaining constant in its position, is supposed to mark the ancient coast-line of this submerged continent." The fauna and flora of the Atlantic islands, bearing close affinity with those both of the old and new worlds, seem to prove that continuous land once existed between both hemispheres. Of the Atlantic type of plants which once flourished on this long-forgotten land, the remains are yet found in the Pyrenees and the hills of Killarney. The fossil remains of the sub-tropical flora of Europe in Miocene times are allied to American forms, which are also found in Japan. Probably these forms had travelled from the western land across the great continent (scarcely to be called mythical) of "Atlantis," and, still journeying when the Eocene period had passed away, spread through Asia to Japan.

On the hills of Scotland and northern England is yet another type of plants, found only in the higher regions. These are the Alpine forms: in number upwards of one hundred. On these hills the flora is quite distinct from the vegetable growth of the lowlands. The plants grow in dense, moss-like masses, adorned with a profusion of comparatively large blossoms of brilliant hues; or the procumbent woody stems bear few hard leaves and small inconspicuous blossoms. Some few of the plants seldom or never flower in this country, but are propagated by buds. These Alpine plants are not indigenous to our islands, as their stunted growth and paucity of numbers seem to prove. Among the mountains of Norway we find identically the same species, but more luxuriant in growth, and in numbers more abundant. Evidently the Scandinavian mountains are the native place of our Alpine plants, and the course of their migration to southern countries may be traced "by the species left behind on numerous intervening points." Three plants of the type, *Saxifragra tricuspidata*, *Kœnigia islandica*, and *Ranunculus nivalis*, are found in the Faroe Islands, but do not penetrate beyond. Further south, in the Shetlands, we reach the southern limit of *Arenaria Norvegica*, a common plant on the Norwegian mountains. Still further south, on the northern shores of Caithness and Sutherland, the *Scotch Primrose*, a true Norwegian plant, reaches its limit. Travelling in a south-western direction, we follow the line of migration of the Alpine plants. "Several species were left behind on the Braemar mountains; while an unusually large proportion is confined to the Breadalbane range, and does not occur further south. Upwards of a score of plants found on the Scottish Alps do not reach the English mountains; while several species are to be met with on Skiddaw and other hills in the north of England, which do not reach the Snowdonian range." We are thus able definitely to ascertain the region from whence this type of vegetation is derived; but how did the migration take place? Again geologic discoveries furnish us with an answer. During the great Glacial epoch, which succeeded the deposition of the Tertiaries, the lowlands of Great Britain were submerged beneath a sea which spread over a great part of Europe. In this sea the mountain ridges of the north formed a group of islands, "whose bases and sides were washed by the cold waves and abraded by the passing ice-floes, and whose summits were covered in many places with glaciers. It was at this period that our now elevated regions received the flora and fauna of the present day. Owing to their favourable position in the midst of an ice-covered sea, the means of transport existed in abundance, and the Arctic flora thus brought down has ever since been able to maintain its footing on the high ground which it inhabits." Nor is it Britain alone which owes its Alpine flora to Scandinavia. It is probable that during the same glacial era the allied forms which are found in European, Equatorial, and Antarctic regions travelled from the same far north, and have become modified during the long intervening ages by the altered conditions of existence.

EXPLANATION OF PLATE.

One example of each of the four groups of plants is given on Plate XI.

Photomicrographs of Diatoms.—MM. A. Traun and Witt, in their work on the fossil diatoms of Hayti, describe their peculiar method of photographing these objects. They first photograph the diatoms with a magnification of not more than 100 diameters, and afterward enlarge the negatives so as to obtain a photograph magnified 500 diameters, proper for photo-printing. Fine details are said to be brought out, which are invisible to the naked eye in the smaller photograph.—*The Microscope.*

Alpine *French*

Microscopic Fauna of the Kennet and Avon Canal, near Bath.

BY THE REV. E. T. STUBBS, M.A.

Plates XII. and XIII.

THE Kennet and Avon Canal is a repository of much more wealth and variety in Microscopic Fauna than many are aware of.

The abundance of vegetation which has from time to time to be cleared away, and the facility of access to its banks, make the Canal rather than the river Avon the better hunting ground; and besides this, its slow current and some occasional side places, which are seldom disturbed, make the Canal a very mine of inexhaustible treasure. There is, I believe, a goodly number of water-plants to be found by those who look for such things, two species of *Lemna*, three of *Potamogeton*, and others; but I have generally found the *Ranunculus aquatilis*, the *Anacharis*, and *Lemna*, etc., the plants near which the greatest amount and variety of Fauna are found. And *Utricularia vulgaris*, a species of insectivorous plant, furnished with traps of a peculiar kind, wherewith to catch unwary *Entomostraca*, possessing as they do little bladders on the stem, which in some way offer attraction to a Daphnia or Cyclops, so that these creatures are induced to push an easy entrance into the tiny bladder, but when once inside, the numerous hairs pointing inwards effectually forbid any egress or escape, and the Entomostracon dies there, and is cast forth a mere shell, denuded of all its integuments.

A slight examination of bottles of water taken from different parts of the canal, will show the following Fauna :—

ZOOPHYTE.

Hydra vulgaris.

ENTOMOSTRACA.

Lophrypoda. *Copepoda.*

Cyclops. 7 sp.

Canthocamptus. 4 sp.

Lophrypoda. *Ostracoda.*
Cypris. 15 sp.
Caudona. 5 sp.
Branchiopoda. *Cladocera.*
Daphnia.
Chydorus.

ROTIFERA.

Ord. *Peritricha.* Fam. *Vorticellidæ.*
Epistylis. sp. 20.
Carchesium. sp. 7.
Cothurina. sp. 18.
Vorticella. sp. 61.
Fam., *Urceolaridæ,* Four Genera.
Genus, *Trichodina,* 5 sp.
Species *T. pendiculus.*

Cilia-rayed.

Floscularia. *Stephanoceros.*

Ciliary disk, continuous.

Melicerta ringens. *M. tyro.* *M. limnias.*
Œcistes.

Ciliary disk, double.

Rot. vulgaris.

Ciliary disk, multiple.

Brachionus pala.
Lophopus.

Such are the contents of a bottle cast carefully amongst the weeds of the canal; these contents might easily be added to, if the search was more closely made and the searcher more untiring. But even these present sufficient variety, and furnish abundance of interest. It will be observed that in this list, there is nothing really rare or strange. All these fauna are familiar to most microscopists, so that what I have now to speak about will be nothing more than a travelling over old ground, and repeating a well-worn and well-thumbed lesson.

I will first take a well-known genus of the fresh-water *Polype,* of the family HYDRIDÆ.

Genus *Hydra*, of this there are four species.

1. *H. viridis.* 3. *H. communis* or *vulgaris.*
2. *H. fusca.* 4. *H. attenuata.*

I have never found *H. viridis* or *attenuata* in the canal, but *H. fusca* and *H. communis* are very common. The genus comes from the tribe Cœlenterata, which is divided into two classes—

(1) *Nematophora*, (2) *Hydrozoa*.

This last has two sub-classes—

(1) *Scyphomedusæ*. (2) *Hydromedusæ*.

There are six orders belonging to this last sub-class, and under the first of these orders, *Gymnoblastea*, there are ten families, of which one is *Hydridæ*, and under this again is the genus *Hydra*.

In this part of the country I have found *H. viridis* only in one pond, which is in the middle of the garden of Charlcombe Grove. Specimens have also been brought to me from a pond in Dyrham Park, but I have never found any in the canal. Neither have I found there *H. attenuata*, and I see in the "Micro. Dictionary" that this species is said to be found in ponds and to be rare.

The distinctive characteristics of these species appear to be as follows:—*H. viridis.*—Leaf-green in colour, body cylindrical or slightly tapering towards base; tentacles, six to ten, shorter than the body, narrowest at margin.

H. fusca.—Body brown or greyish, lower half suddenly attenuated; tentacles, six to eight, several times longer than the body.

H. vulgaris.—Body orange-brown, yellowish, or reddish, cylindrical; tentacles, seven to twelve, as long or longer than the body, tapering.

H. attenuata.—Body pale olive green, attenuated below; tentacles pale, considerably longer than the body, six to ten in number.

It will be perceived that the principal distinguishing marks of the various species are the colour and the length of the tentacles. The habits and colours of all the species are the same.

If a Hydra is caught and kept well fed and in a healthy condition, it will present many points of curious and unexpected interest. The entire mass of the body and tentacles is formed of sarcode, and on the surface it is frequently irregularly roundish or nodular, or exhibits spiral or other raised lines, and it contains numerous vacuoles within. And if a Hydra be crushed between glasses, the substance breaks up into globular, minute masses like cells, and which often continue expanding and contracting like amœba. Imbedded in the superficial portions of its substance, and more especially in the tentacles, are certain curious bodies called the stinging-organs. They consist of an oval, truncate, firm capsule of comparatively considerable thickness, marked by a double outline; within this capsule is contained a very long and slender filament. I have seen it extend to about ten times the length of the capsule. It is apparently of great strength, though of such tenuity as to be almost invisible. At the base of this filament are four minute spines. In the undisturbed state of the Hydra this filament is coiled up along with the spines in the capsule; but if the creature is squeezed or touched or heated slightly, the spines with this filament fly out with great velocity. From the fact that formic acid appears in the capsules, these spines seem to possess a stinging power; and this may account for the apparent numbness which some have perceived in those Entomostraca which have been pierced by them. I have seen an Entomostracon which was pierced by one of these darts and held captive by the slender filament, apparently waiting until the filament should be drawn in, and one of the tentacles stretched forth to enwrap the prey. For the prey of the Hydra consists of Entomostraca, small Annulata, etc., and very rapacious it is; but in what manner it knows where its prey is, while at a distance, so as to dart its harpoon and pierce it, is a mystery, since no trace of eye or eye-spot can be seen.

There are few facts more extraordinary than the strange power which the Hydra has of reproducing its lost parts; indeed the power goes much further than mere reproduction. If a Hydra is well fed and in vigorous condition, it may be turned inside out, since its body is merely a hollow tube; it may be cut transversely or longitudinally, and will still outlive the process, and the excised parts will be reproduced, the internal surface will change places with the external, and the creature apparently suffer but small inconvenience. I have said that in order to prosecute these and other experiments with Hydra, they should be in thorough health and well fed; their food consists of small Entomostraca and Annelids. But it would be well in supplying food to the Hydra to take greater care than I did on one occasion. I had procured a very fine specimen of *H. viridis*, and proceeded to write a short paper to read, if there was an opportunity, at the next meeting of our Society; but reflecting that the meeting would not take place for almost three weeks, I thought it would be as well to give the Hydra some food, and placed in the water with it two specimens of *Candona repens*. The next morning I found that the dinner had devoured the diner; the Candona were lively and active, the Hydra was represented by only a small mass of green sarcode.

Hydra, and especially *H. viridis* and *H. fusca*, are infested on their cuticular surface by a parasite of the order *Peritricha*, Pl. XII., Fig. 1. Numbers of these can be seen moving rapidly over the body and tentacles; they are called *Trichodina pediculus*. There are other species of the Trichodina found infesting fish and crustaceans, and the principal difference between the marine and fresh-water species, is that the body is discoidal in the fresh-water species, and turban-shaped in the sea species, (see Plate XII., Figs. 2 and 3.) T. pediculus: the body is conical, discoidal, or hour-glass shaped, according to the conditions of expansion or contraction, the height when fully expanded almost equals, but scarcely ever exceeds the greatest diameter. It moves by means of ciliary wreaths placed on the posterior and adoral margins. The cilia of the posterior margin being the longest, and are inserted on the inner side, and at the base of a thin transparent annular membrane or velum, into which the body of the posterior margin is produced. The horny ring of the acetabulum, Fig. 3, is supplemented by a wreath of horny denticles consisting of an internal and external series, each numbering about 26; the denticles of the outer series are the larger, and are short, thick, and claw-like; those of the inner set are attenuate, sharply pointed, almost straight, and extending to the centre of the interior discoidal area, composed in each instance of a more solid radial portion, and a membraneous, weblike lateral extension, endoplast, bandlike, or moniliform, curved; greatest height and diameter when fully expanded one three hundred and sixtieth of an inch.

In the memoirs of the Boston Society of Natural History, 1865, by Prof. H. J. Clark, the basal adherent apparatus is described. It appears that they reproduce by gemmation. The T. pediculus does not apparently injure its host, and makes use of him only for locomotion.

There is a second infusorial guest which the Hydra often entertains, the Kerona polyporum, see Plate XII., Fig. 4. When the two abound, it may not be unfrequently observed that the Trichodinæ mount on the backs of their companions, and thus utilise them for the enjoyment of locomotion without having to exert themselves. According to Ehrenberg, the Keronæ, of which there seems to be but one species, are animalcules, free swimming, persistent in shape, flattened or plano convex, subreniform, possessing no true frontal, ventral, or anal styles ; but in place of these several arcuate rows of short ventral setæ, and other longer setæ, forming a continuous fringe round the peripheral border. Length of this species a one-hundred and ninetieth to a one-hundred and twenty-sixth of inch. It is found in fresh water, on the surface of the fresh-water polypes, Hydra fusca and H. vulgaris, and on those creatures in company with Trichodina pediculus. It was originally premised that this species preyed upon the living tissues of the polype, which serves it as an host, the characteristic thread-cells of the higher organism being frequently found inside it. Such structures, however, are only incepted with other waste matter thrown off from the surface of the polype's integument, and in the removal of which its tiny guest plays the rôle of a useful scavenger. Other food matters, such as monads, desmids, and diatoms, are devoured with equal avidity, and form an important addendum to its customary bill of fare.

Among the Entomostraca, which inhabit our canal, we find of course Daphniadæ. The Daphnia pulex is well known, and must be familiar to all. There are seven species of Daphniadæ.

1. *Daphnia pulex* the best known.

2. *D. psittacea.*—Chiefly distinguished by a long serrated, sharp spine on the posterior angle of the shell, which character it also possesses with the next.

3. *D. Schœfferi.*—This species is, however, distinguished from the former by the smallness of its head, and the fine reticulations on its shell.

4. *D. vetula.*—Ciliated around the margin of the Carapace.

5. *D. reticulata.*—This is, as its name implies, covered with fine hexagonal reticulations; it is destitute of a beak.

6. *D. rotunda.*—The spine is very small, and is turned backwards.

7. *D. mucronata.*—The head of this species is triangular, and the anterior edge of the shell is straight.

Five at least of these species may be found in the canal, perhaps all of them; but as for myself, I have not seen the two last, *D. rotunda* or *mucronata*, though the first is common enough about London. I do not propose entering into a minute description of this genus, as it must have been often studied by everyone. I will confine myself to some remarks upon portions of the structure that are more difficult to perceive, and thus may have escaped notice. And I will take the *Daphnia pulex*, the best known and most widely distributed, as well as the largest of the seven species.

Just below the beak are the superior antennæ, Figs. *6a*, *7b*, 8, which are large and long in the male, but less conspicuous in the female. If you confine the creature so that it shall not be able to move, and turn it with its beak facing you, and manage your light well, you will not only see the antennæ clearly, but with a suitable light will make out the arrangement of the setæ, which fringe the extremity of each antenna, and you will see that there is a double articulation for each. There is a double spine at the base of the inferior antennæ, V shaped, Fig. *6c*, the use of which I am unable to determine. These setæ are of two kinds, an outer row encircling the outer edge of the extremity (these are very short and stout), then an inner group of setæ, long and very slender. Holding the Daphnia in the same position, and with a good light the labrum and mouth can be seen, but in order to see the action of the labrum in the act of swallowing, a side view must be had. The particles in the water on which the creature feeds, are carried to the mouth by a current created by the movement of the feet; they enter between the valves of the carapace at the posterior feet, and pass upwards in a gradually gathering mass between each successive pair of feet, until they reach the mouth, where, I suppose, the superior antennæ that I have described, act the part of maxillary palpi, and distinguish between what is and is not fit to be swallowed.

The Daphnia is extremely prolific, and with the most moderate compilations, making the largest deduction for the number of males, and for accidents to the young, a female Daphnia pulex will produce 800 eggs in a year, or, as the females begin to lay when three months old, 184,400 females will at the end of a year have sprung from one parent. This fecundity is, however, outstripped by the Cyclops quadricornis, which, according to Farine, will produce 3,331,641,840 females in the space of twelve months.

Let me just mention that I have found Plumatella repens, Plate XIII., Figs. 9, 10, and Lophopus, upon decayed wood lying at the bottom of the canal. I need hardly say that these seem like bits of jelly, shapeless, formless, lifeless, when taken out of the water, but when placed in the zoophyte trough with some of *their own canal water*, and left in quiet for a little, these bits of mucous-looking substances will expand in groups of tentacles with cilia coursing round them, all in the same direction, and directing currents of water into the common oral aperture.

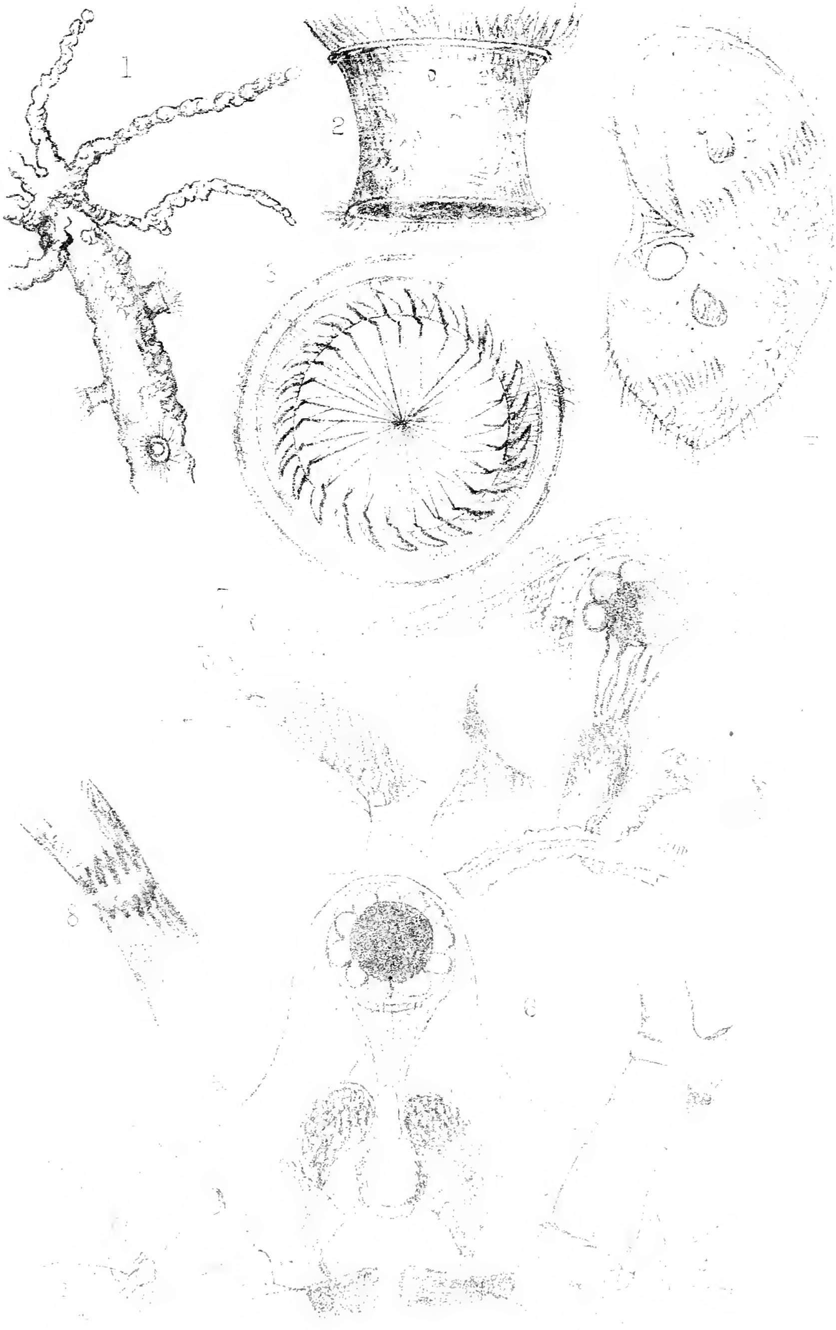
Of the family of Vorticellidæ, there is to be found some of the best species of the genus Vorticella, also Carchesium, Epistylis; all these can be found when carefully searched for, and all of them will repay study. I will only say, that the pedicle, Fig. 11, by which these creatures are secured to their resting place, has not received sufficient study. Saville Kent says, that with a power of 600 diam., the central muscle-like cord, Fig. 12, exhibits the aspect of being finely and evenly striate transversely. And that under 1,800 diam., these transverse striæ become resolved into parallel rows of minute longitudinal striæ, having 10 in each row, as seen in optical section. This muscle is disposed in an extended spiral form within the hyaline sheath, and is continuous with a delicate muscular sheet or layer, which passes up into the walls of the body, and underlies the cuticle.

The kingdom of the Rotifera is also well represented in the Fauna of the canal; indeed, for the finding of some of the most interesting of these, I was indebted to a brother member, who told me that in a certain spot I should find Carchesium, and when I went there, I had a delightful haul of Melicerta ringens, Floscularia regalis, Œcistes, Stephanoceros Eichornii, and Limnias ceratophylli. Of course, I need not say that Rotifera vulgaris is to be found, but that creature seems to be present everywhere.

The Melicerta is too well known, and too long known, to need much from me. But I may say, that I have found the Melicerta in the greatest abundance in the canal. Only that for this, as well as for most Rotifera, you must search among old weed; search in some quiet, undisturbed place where the dredge has not passed, at least for some months, and where the water is not stagnant. It is interesting to note a Melicertan in different stages of growth, to see its birth as it escapes from the tube of the mother, and swim away free and unattached, until it fixes itself in some spot an hour after its birth, and begins to build its tube, commencing near, but altogether on the weed where it has fixed its foot, and watch the formation of each pellet, which, when the creature is undisturbed, takes about 15 or 20 seconds to form. And, if you supply the water with water tinged with fine indigo or carmine, you will not only see the bricks become red or blue, according as different colouring matter is supplied, but, what is of real importance, you will see the stream of coloured particles passing round the four lobes of the corona, down the buccal funnel, between the horny lips where the particles are crushed between the Mallei, and you can, by the colour trace the particles on their way into the stomach. Hudson, in his work, says, that in the United States, Melicerta occurs in large clusters, a number of young attaching themselves to the parent tube; and some tubes of these clusters exceed the largest known English specimen. In one case, the tube of the parent was the ninth of an inch long, the tenant must have been one-eighth inch in length, and the author adds that he found this great tube, composed of 6,000 pellets, ranged in 240 rows one above the other. The tube of this Rotifer can be easily seen with the naked eye.

But, perhaps, the most beautiful of all the Rotifera is the Stephanoceros (Fig. 13). I have found very fine specimens in various parts of the canal, and anyone who has seen a Stephanoceros in a favourable position, and under a proper light, will think it a strange, lovely, beautiful creature, a small pear-shaped body, with rich green and brown colours within, lightly perched on a tapering foot, and crowned with a diadem of five curved crystal arms, each fringed with the daintiest crystal plumes, while the whole is set in a transparent vase of cylindrical shape and most deli-cate texture. If startled, it will close up its five arms, and retreat into its tube for safety, but soon emerge again. The crown is almost a sphere. The setæ which fringe the arms are much longer than they at first appear; they are gracefully curved, and taper off into lines of exquisite fineness. Those of one arm interlace with those of the arms at either side of it, so as to form a transparent living cap of the finest network, into which it is very easy for its prey to enter, but out of which it is hardly possible for anything to pass without touching some part of those sensitive meshes. The instant anything enclosed within the arms does this, band after band of the cilia lashes at the runaway, a swift current is set up, and the captive is thrown back into the vortex which draws it into the buccal aperture, through which it passes between the jaws of the mallei, and then into the stomach (Fig. 13). If a Stephanoceros, fully expanded, is placed in a favourable position with the crown turned towards the observer, about 45° from the plane of vision, and a ray of oblique light directed upon the specimen, the cilia will be seen to curve inwards, the cilia of one horn of the crown almost meeting the cilia of the proximate horn, and curving inwards so as to render ingress into the space enclosed by the crown exceedingly easy, but egress most difficult. Occasion-ally, one can detect a fitful ciliary wave running round the top of the coronal cap, but only for the briefest duration.

I have touched upon only a few of the microscopic organisms of our canal, and with those few that have been mentioned all are doubtless tolerably familiar. But even with the most familiar, there is still much to study, and more to discover. As, for instance, what seasons are most favourable to one kind, and what to another; what Fauna come out more abundantly in sunshine, and what in shade; which are nocturnal in their habits, and which love the light of day? And, with all that yet lies before us to discover in microscopic Fauna, we may all deem ourselves fortunate in having a canal so replete with treasure within such easy reach.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EXPLANATION OF PLATES XII., XIII.

Fig. 1.—Hydra, with *Trichodina pediculus*.
,, 2.—*T. pediculus*; side view, showing upper and under cilia.
,, 3.—Ditto, under side, showing the adherent apparatus, ciliary crown, uncini, etc.
,, 4.—*Kerona polyporum*. Ventral view.
,, 6.—*Daphnia pulex*; front view of head, seen from underneath, showing the double basal joints of superior and inferior antennæ. *a.*, *b.*—Superior antenna. *c.*—Inferior antenna.
,, 7.—Ditto, side view of head and back
,, 8.—Ditto; detailed view of extremity of a superior antenna, showing the short strong exterior setæ, and the long fine interior setæ.
,, 9.—*Plumatella repens*, with ova. General view.
,, 10.—Ditto; enlarged view of a polypide, shewing cilia circling round each tentacle.
,, 11.—*Vorticella*. General view.
,, 12.—Ditto: a zooid, greatly magnified to shew the transversely striated muscle of the pedicle.
,, 13.—*Stephanoceros Eichornii*; sketch of the crown in a favourable position and good light, shewing the inward curve of the cilia.

INTELLIGENCE OF ANTS.*—I send you the following regarding ants, by Mr. W. E. Bosworth, of this city, written out at my request, which seems to me an interesting and at the same time a somewhat rare observation. It is almost exactly similar to the account by McCook of the sleeping of harvesting ants of Texas, as quoted in G. J. Romanes' "Animal Intelligence," p. 84. I do not recall any other instance given of the sleeping of ants:—

"At different times, and for more than one season, I was favourably situated to see the movements of quite a large colony of small black ants, as they passed to and fro in their busy haste over a board floor, going, as I supposed, for their supply of water, which was in the direction of a small stream close by. While watching their quick, eager movements, there were several along the line that attracted my attention, as they remained in one place so long that I concluded they must be dead: and although they were directly on the line of march, and n the way of the others, these passed on, paying no attention to them whatever. At another time I noticed that one of the ants, supposed to be dead, got up, and walked off as lively as the rest; and, while watching this one, another close by began to slow up, and seemed to totter in his gait, and finally came to a dead halt. After seeing this, it occurred to me that the one had just waked up, and the other had just gone to sleep. In order to test the matter, and gratify my curiosity, I concluded to experiment on some of them. With a fine straw they were gently rubbed on the back. This mild treatment did not make the slightest impression on them, but a sharp push seemed to take them completely by surprise, and to fully arouse them. For an instant they seemed lost, circulating around, running up and down, and finally starting off with the rest. This was repeatedly tried with the same result. Their movements on being disturbed very forcibly reminded me of a child when suddenly waked out of sound sleep."—J. H. Howe, Louisville, Ky., Nov., 1889.

* From *Science*.

On the Presence of a Tarsal-comb in Spiders of the family Theridiidæ.

By Frederick O. Pickard Cambridge, B.A.

ALTHOUGH there are few naturalists who make a systematic study of the ARANEIDA or spiders, yet there are many fond of microscopic research who find a wide and interesting field for their investigations in the anatomy, external and internal, of this hitherto little known order. It occurred to us then that a short account of a structure which, so far as we are aware, has never been made special mention of before, though it probably has not escaped notice, together with an account of its use to the individual, and possibly minor importance in schemes of classification, might be both welcome to the seeker after curiosities for the microscope and general naturalist, as well as to the more systematic student of the spider world.

As to the tarsal appendages of spiders in general (the term tarsal referring, of course, to the last joint of the legs), we might remark that they consist of claws of various number, size, and conformation; some plain, others serrated or toothed on the inner margins, all apparently specially adapted for the conditions under which the owners thereof exist. As we should naturally conjecture, those spiders which construct complicated snares usually possess a higher development of the tarsal claws, specially constructed for the seizing hold of lines, and the general manipulation of tangled ropeage. The *Epeiridæ* (wheel-web spinners), *e.g.*, possess three tarsal-claws and several more subsidiary claws, which they must find highly useful in handling their delicate lines. The *Agelenidæ*, another family constructing funnel-shaped, sheet-like snares, also possess three tarsal-claws; whereas the *Drassidæ*, a family whose members construct tubular retreats in holes and crannies, rejoice in only two claws. The family *Dictynidæ* possess a further development in web-weaving apparatus, called the calamistrum, the name given to a longitudinal series of stiff, curved bristles situated on the upper side of the metatarsal (or penultimate) joint of the fourth (or hind) pair of legs. These instruments, used in conjunction with an extra pair of spinners (and their accompanying internal silk-glands), provide a very finely fibrous, white, woolly silk, which is laid over the webbing for the purpose of physically bamboozling any unfortunates who may fall in.

These short remarks have been made to show how important the development of the tarsal-claws are for purposes of classification; not indeed in many cases of primary or even of secondary importance, but, at all events, forming an element that must by no means be overlooked, more especially when we recollect that habit, circumstances, and capabilities of development react continuously, the one upon the other, to form decided and important modifications in structure, thus rendering it necessary, when attempting to classify members of such an order as the Araneida, to take into consideration their peculiar mode of life and living, together with the influence it has upon their physical development as well as to refrain from omitting to consider modifications in structure (however subsidiary they may seem) with their bearing upon the habits and capabilities of those individuals which exhibit such, and consequently upon their position in systematic arrangements.

The mention of the calamistrum brings us at once to the immediate subject-matter of this paper. While investigating the habits of a member of the genus *Theridion*, of the family *Therididæ* (the members of which construct a mazy, indefinite snare of interwoven, crossing lines; or else a horizontal sheet-like web), and having for the purpose of observation, specimens of both sexes in confinement, we were attracted by a peculiarity we had not before noticed in the construction of the snare.

When at large, this species, *Theridion tepidariorum*, C.L.K., constructs in our hot-houses—for in these comfortable quarters alone the species thrives—in this ungenial clime, large snares, often two feet in height, consisting of scattered upright lines, interwoven with cross lines attached to the uprights at all angles, and fixed to neighbouring convenient objects.

Now, it has ever been a matter of surprise to us, for we have pondered and considered these things much, while indulging in the matutinal cigarette amongst the conservatoried floral treasures of our friends, that a comparatively small and quiescent spider as this should be able to ensnare, overpower, and utilise as food such large, fierce creatures as *Amaurobius similis*, *Dysdera Cambridgii*, and other large spiders, besides immense wood-lice, harvestmen (*Phalangidæ*), large iron-armoured rhyncophorous beetles, *et hoc genus omne*, which we have observed hanging helpless in their toils, and moreover, that the capture should be compassed merely with the assistance of a few (for they are not very dense) crossing and recrossing lines. The falces (jaws) of our friends, like those of almost all the species of *Theridion*, are on a scale decidedly feeble, and by no means a match in the snapping line, for such a beast as *Amaurobius*, who must be a perfect ogre to the denizens of our greenhouses.

We were not, however, long without a clue to the mystery; we observed that upon these lines, chiefly at the points of their union one with the other, the spider was in the habit of laying a light, very fine, flocculent mass of silk, consisting of quantities of the most delicate silken strands. This woolly mass has a very adhesive property, due, however, to the exceeding fineness of its constituent fibres, and not to any non-sölidifying, gummy fluid deposited upon it, as is the case amongst the wheel-web spinners. This explained to us at once how the strongest victim becomes so hampered and unable to act in self-defence, that our small friend can deal with them with such comparative ease; for once let a *misérable* touch this treacherous wool, such a tanglement results that the unfortunate may abandon all hope of again extricating itself therefrom. The spider herself inspired with horrid purpose shakes the whole web in a series of jerks, to eliminate, if possible, every chance of escape, and evidently by way of furthering the complications wherein her wretched victim is involved.

So far, so good; the existence of the woolly webbing and its use is evident. The next puzzle was, How is it produced? We secretly hoped we might discover a true calamistrum, and extra spinning organs and glands, which would account for it, because the only other spiders (so far as is known) who prepare such wool, viz.: the species of the family *Dictynidæ*, and those of the family

Uloboridæ, manufacture their flakey* silk with the curved series of bristles on the metatarsi. But no ; there appeared to be no calamistrum, and we sought elsewhere for explanation. After very little examination with an ordinary platyscopic lens, we ascertained the presence beneath the tarsi of the fourth pair of legs of a comb-like series of curved spines, unlike anything noticeable in other spiders, so far as we have observed them.

A detached leg speedily placed beneath an inch objective confirmed our observation, and our hasty conjecture as to the import of this comb, which we then saw to be exactly adapted to the carding out of multitudes of fine threads, each thread kept separate, although we had not yet actually witnessed the operation. This comb consists of nine stout spines, situate in single rows beneath the tarsus of the hind pair of legs only, firmly articulated to the joint, strongly curved and directed towards the apex of the joint, their slender points aculeate and slightly, not abruptly, recurved; their outer sides being emarginate with a series of tooth-like barbs, becoming more highly developed towards the foot-claws. These are supplemented on either side by other stout bristles. (N.B.—That which is a hair under a pocket lens becomes a bristle under a higher power, and the bristle becomes a spine, when described.) Further up the joint the spines begin to show a tendency to curvature and toothedness, developing only to a definite extent, however, towards the apex of the joint, showing probably that the origin of this comb was due to a chance unevenness in the surface of the curved bristles, which has been accentuated, owing to the advantage their presence has conferred upon their owners, becoming from generation to generation stouter and more adapted for real utility, finally resulting in the highly useful instrument we now observe.

Of course, this is a mere conjecture drawn upon the line of thought which is predominant in our minds, now brimful of ideas of natural selection, adaptation to environment, and the survival of what is most fitting and useful to the individual. To speak of a *chance* variation is to shirk the vital point, viz., the real origin of

* Flakey and Flocculent are misnomers when applied to this silk. They must here be regarded as applying to the appearance, and not to the real nature of the silk.

such variations, and the explanation of the use of a rudimentary organ. Natural selection, as propounded by Dr. Darwin, does not pretend to account for the rudiments of organs, though, once set going, the future progress and perfection of them is easy enough to understand, and although Dr. Wallace conclusively proves the extreme variability of living organisms, rendering it impossible to predict in what direction a development may take place, yet this does not quite account satisfactorily for the fact that these developments appear to take place just exactly where they are needed; unless we suppose that the psychical forces embodied by an organism are ready on the slightest hint from without, through the media of nerve fibres, to force a development in the line suggested by peculiarities of environment.

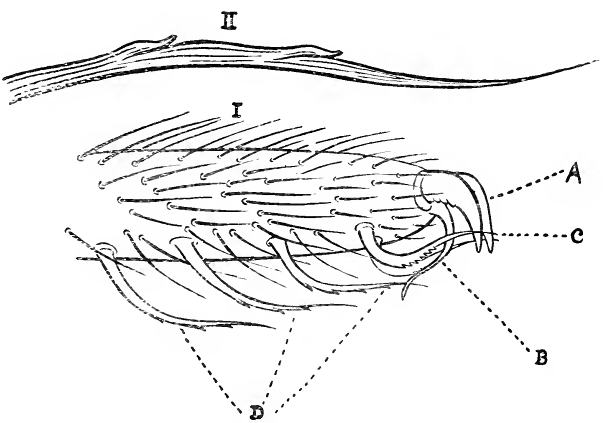

Fig. 1.—Apical portion of the tarsal joint of the fourth pair of legs of a female *Theridion tepidariorum*, showing three of the spines of the tarsal comb at D, the two superior claws at A, the central inferior claw at B, and a pair of auxiliary claws at C.

Fig. 2.—Represents the extremity of one of the spines shown at D, in Fig. 1, exhibiting the barb-like emarginations.

At Fig. 1, may be seen the apical three of the nine spines of the tarsal comb, D D D, with their characteristic curve and barbs; while at A may be observed the two normal tarsal claws, at

B, the third elongate central claw, and opposing this at C, are two serrated claws, or rather, perhaps, curved spines of an origin similar to those of the tarsal-comb proper. We have no space to dilate upon the significance of this arrangement of tarsal claws or to compare them with those of other families and genera, interesting though such a comparison would be.

At Fig. 2, is represented one of the spines of the comb, highly magnified, to show more accurately the nature of the barbs.

Thus far as to the instrument. Next, let us consider its relation to the flocculent wool, and its great assistance to its owner in the capture of victims. As we have said, when any creature touches the flakey webbing, it immediately, as is not unnatural, commences a kicking protest; all to no purpose, however, for the watchful old lady above has long been awaiting the arrival of a something or other in her snare, and after a preliminary shake or two, she rushes in and commences to offer assistance in every way to her struggling guest—every assistance, that is, which may complete its final discomfiture.

For this purpose, she makes great use of the curious instrument we have been considering above. Taking up her position beneath the disturbance, which is often very great and withal dangerous, should the cause happen to be anything large and savage, keeping it well out of the way with her very long fore-legs, by alternate sweeps of her tarsal-combs over her spinners, she conveys a sheet of fine fibrous silk to all points of the kicking; these movements being accomplished with marvellous rapidity, so rapid that the eye can scarcely follow them, until the victim, hampered on all sides with the treacherous silk, bound hand and foot, is left to think matters over in peace and quiet, until such time as our friend, being hungry, begins to nibble at a protruding extremity, a process which we have noticed somewhat disturbs the meditations of the prisoner.

At first, we were of opinion that the silk was laid on in flakes—that is, each application of a comb carried a flake of silk of fine fibres, but we now believe that the stream of fine lines is continuous, each comb taking up the extraction and application in turn. It will now be noticed how admirably adapted are these combs for this purpose. It will be seen that the barbs of the spines will, when the tarsus is swept over the spinners, entangle and draw from the countless little silk ducts, or spinning spools, a quantity of fine threads, which are then conveyed to the points required, the spider's long legs effectually keeping her out of all danger. Not only, however, are the hind legs used for the purpose of enswathing the victim; I have often noticed that they are also made use of for drawing out a single thread (or what appeared to be a single thread), and of affixing it to any points of 'vantage required. I have not yet actually observed the laying on of the flocculent silk over the tangled single lines, but probably it is laid on with the tarsal combs after the manner exhibited in the capture of the prey, but whether at the time of spinning the lines, or afterwards, I cannot certainly declare. It would seem to be most probable that it is accomplished after the lines are laid out, and we hope shortly to be able to confirm or refute this opinion.

The Rev. O. Pickard Cambridge* mentions the mode of enfolding the prey by *Pholcus phalangioides*, by means of alternate movements of the hind legs. This species, common in the south, is not found in these northern regions (Cumberland), and not having any specimens by me, I am unable to say whether the tarsal-comb is also present in this species, though I should expect it to be so. Fig. III. represents a female, *Theridion tepidariorum*, in the act of securing a small woodlouse; the males also possess evident tarsal combs, but they are not so conspicuous as those of the females.

It only remains to show how far this structure is of importance in the systematic classification of the family *Therididæ*.

We find that this comb exists in a more or less developed form in all those genera, comprised by M. Simon in his section, *Theridionini*. He has divided the *Therididæ* into *Theridionini* and *Erigonini* (amongst other sections). None of the genera composing this latter section possess the comb; *Linyphia*, e.g., *Tmeticus*, *Bathyphantes*, *Drapetisca*, *Tapinopa*, *etc. etc.*, show no signs of such a structure—the nature of their web enables them to do without; while the genera *Theridion*, *Crustulina*, *Steatoda*, *Ero*, *Episinus*, *Pholcomma*, all present the same characteristic comb; the genus

* Ann. Mag. Nat. His., Feb., 1878.

Nesticus exhibits it to a rather less extent, bringing it closer to members of the genus *Linyphia* in the section *Erigonini*. And although we attach no very great importance to this tarsal-comb,

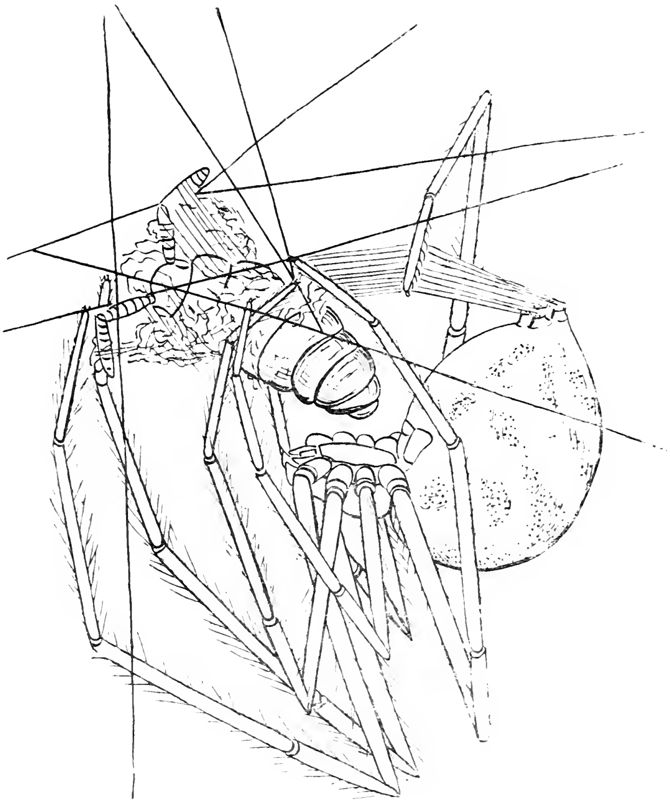

Fig. 3.—Represents a female *Th. tepidariorum* in the act of capturing a wood-louse, and shows the manner in which the hind legs are used in enswathing the victim.

not greater, that is to say, than is usually accorded in this order to minor structural details, whose importance, too, varies considerably in different families, yet this peculiarity is very easily noticed, and together with the other characters, such as absence of stout spines upon the legs, inclination of the maxillæ over the labium, and the somewhat shaky character furnished by the small size and weakness of the jaws, provides a quite natural character for distinguishing the above-named genera (with the exception of *Ero* and *Theridiosma*, which are placed by M. Simon in other sections), from all others, of the family *Therididæ*. We are not aware that this character has been recorded previously, in its full significance, although many observers of the habits of spiders have noticed this peculiar mode of enfolding the prey in members of the *Therididæ*.

Dr. McCook* justly remarks, in words to this effect, that Dr. Thorell's system of dividing spiders according to their habits, *i.e.*, mode of providing themselves with the necessities of life, will be interesting to naturalists because it bears upon the correspondence between structure and economy, and the *value of habit as a factor in classification.*†

Now it would seem that either habit produces variation in structure or slight variations in structure give rise at length to peculiar habits, or they both arise simultaneously with mutual influence, and whether the habit has resulted from a modification of the structure, or the structure from the habit, or each acted and reacted upon the other, certain it is that we cannot now (in the case of the spiders at all events) well conceive of, or deal with the one apart from the other, and that, therefore, they must both perforce be taken into consideration in schemes of classification, a conclusion to which Dr. Thorell has long since come.

So that we would point out that we must not look to habit, *per se*, nor to structural modification, *per se*, as valuable factors of classification, but to both regarded as bearing the one upon the other, and our efforts, therefore, should be directed to ascertaining the relations of the one to the other. This is what we have been endeavouring to do by our humble researches recorded above. Hoping that we have been successful in so doing in connection with the tarsal-comb of the *Therididæ*, and that we may be the means of inducing others to take part in this, the most interesting portion of the whole field of natural history exploration, we must close our somewhat incoherent remarks, and refraining from

* Proc. Acad. Nat. Sci., Philad., 1882, pp. 254—7.

† The italics are ours.

entering upon other most interesting points, express a hope that we have not exceeded the space which our kind editors have allotted us.

Since the above was written, I have received the first volume of an admirable work, on the spinning habits of American spiders, by Dr. McCook, which has given me much pleasure in perusing, in which he deals very fully, and in a charmingly analytical and thoroughly scientific manner, with the various forms of webs and silken products of spiders, chiefly of the group *Orbitelariæ*, or wheel-web spinners. Dr. McCook, in speaking on page 205 of flocculent webbing, evidently also is under the impression, as I have myself hitherto been, that spiders alone which possess the calamistrum and cribellum, were capable of producing this peculiar form of silk.

Again, on page 351, he says, "One other fact remains to be noted, and I confess that I speak of it with considerable hesitation. On one occasion, while studying the snare of a species of *Theridium*, which I took to be *T. differens*, I was surprised to find it distinctly marked with viscid globules." I am now in a position to confirm this observation, and I surmise that it was probably not an abnormal occurrence, as he suggests might have been the case, because I have in many cases, I may say in all cases which have come under my observation, noted rows of viscid globules, similar to those on the webs of the *Epiridæ*, upon the crossing and perpendicular lines of the webs of *Theridion tepidariorum*.

I have, moreover, noticed during the process of enfolding the victim, that the thread that is drawn out is often strung with beads of viscid fluid, thus showing that probably the deposition of these beads, and the spinning of the thread, are always done at one and the same time. But the viscid globules do not appear upon the flocculent wool hung around the web, so far as I have myself observed.

Again, there is another interesting point in connection with the tarsal-comb. Dr. McCook has established the fact, that the spiders of the group *Theridiosoma Cambr.* spin snares of a decidedly orbicular tendency; he has wondered if it were possible that, what seemed to him to be spiral cross lines on the web, might be a flocculent web of a spiral nature; but he remarks that "this is always associated with the calamistrum and cribellum," as we remarked above.

Now that the fact has been shown that the tarsal-comb will produce such silk, it would have been possible that *Theridiosoma* might have done so by the same means, but for the fact that I am unable to detect anything like a tarsal-comb, such as has been described above. This genus has hitherto been included by M. Simon, as well as by its founder, the Rev. O. Pickard Cambridge, F.R.S., in the family *Theridionidæ*; but doubtless, in consideration of the form of snare, it will in future be placed amongst the *Epeiridæ*, where it would have been placed no doubt at once by the founder of the genus, who was well aware of its close affinities with those spiders, had there been any opportunity of observing the habits and confirming the observations made by Dr. McCook in the case of the American spider of this genus.

Paper.—One of the best-utilised waste products in Australia is said to be the husks of Indian corn. These are boiled with an alkali in tubular boilers. The glutinous matter is pressed out from the fibre by hydraulic apparatus, leaving the fibres in the shape of a mass or chain of longitudinal threads, interspersed with a mass of short fibres. The paper for which mostly the short fibres are used—the long fibres constituting the material for spinning—is stronger than paper of the same weight made from linen or cotton rags, its hardness and firmness of grain exceeding that of the best-dipped English drawing-papers, being specially adapted for pencil-drawing, stenographic writing, and water colours. Its durability, it is claimed, exceeds that of paper made from any other material, and the corn-husk paper is not destroyed by insects at exposed points. If the gluten is left in the pulp, the paper can be made extremely transparent. Again, the fibre is easily worked, either alone or in combination with rags, into the finest writing or printing papers; it also takes readily any tint or colour, and can be worked almost to as much advantage into stout wrapping-paper of superior quality as into fine note and envelope paper.

The Trees of the Wood.
I.—Beech.

By Catharine F. Ripley.

Plate XIV.

THE Beech (*Fagus sylvatica*) is a tree of the first magnitude, frequently attaining a height of 90 or 100 ft., with a circumference of trunk from 12 to 22 ft. It is generally allowed to be one of the four indigenous trees of our island, although so great an authority as Cæsar states that in Britain all sorts of trees grow, *except* the Beech and the Fir.

It is in the great chalk districts that we find the Beech in its native splendour, and especially so in the forests and woods of Bucks, Herts, Berks, Hampshire, and Kent. It will grow well on most dry soils, but it is always found in the greatest perfection in a sandy, calcareous loam, or in fresh sandy loam on clay or rock. It belongs to the Order Cupuliferæ, the leading characteristics of which are—flowers of two kinds on the same tree, and the fruit enclosed in a capsule.

Many splendid examples of old or large trees are met with in various parts of the kingdom. Of these the King's Beech, at Ashridge, has a clear trunk of 75 ft. and a full height of 118 ft. The Knowle Beech, in Kent, is 27 ft. in girth, with a diameter of head of 352 ft. At Bicton, in Devonshire, a famous Beech tree is 29 ft. in girth, and over 100 ft. in height. The Forest of Dean is celebrated for its magnificent Beeches; the five High Beeches near Coleford Meend are noble trees, and, as they grow on high ground with no other large timber near them, they form a very fine object, and can be distinguished from a great distance; the third is the tallest—its height is 108 ft., girth, 18 ft. 6 in., at about 6 ft. from the ground. The Danby Beeches, also in the Forest of Dean, rival the High Beeches in size and beauty; the largest is 21 ft. in girth, at 5 ft. from the ground. Some beautiful examples of Beech are also found in the other great forests of the kingdom, particularly in the New Forest. At Norton Priory, Cheshire, some trees measure from 11 to 15 ft. in girth at about 3 ft. from the ground. The Burnham Beeches, near Maidenhead, Berks, are unique in appearance, being very curious pollard trees of a great age and girth; many interesting stories are associated with them. In the parts of Bucks where the Beech especially abounds, it is frequently over 100 ft. in height. There are also noble trees in the parks and woods of Yorks., and in the stately avenues of the far-famed Dukeries, on the borders of Yorks, Notts, and Derbyshire, where park joins park, and long vistas of tree-lined paths delight the eye of the nature lover. In Scotland several fine specimens of Beech are met with, and one near Edinburgh has a very massive trunk.

But it is impossible in a brief space to enumerate the various large examples to be found in different parts of the country, as the tree is so commonly cultivated that there is scarcely a district or park in the kingdom which does not possess fine or well-grown specimens; some noticeable for the splendid height and erectness of the trunk, and others for their uncommon girth or extensive spread of the branches.

With regard to the circumference of trees it should be noted that there is much uncertainty about the various measurements frequently given. Some are evidently taken too near the base, and in that case it can scarcely be called the true girth of the trunk. When possible, that is when the lowest branches do not start from too low a point, the measurement should be taken at a distance of from 3 to 5 ft. from the ground, which distance should always be carefully stated.

As an ornamental tree the Beech has the highest claim on our attention. First, the uncommon beauty of the trunk, with its thin smooth bark of a changeful grey, white and sparkling in the sunlight, interspersed with patches of vivid yellow-green lichen, forming most picturesque effects of light and shade; and secondly, from the unusually graceful sweep of its long and slender branches, turning upwards towards the extremity, their lovely curves intercrossing and interwining together. It is beautiful as a winter study, when the lanceolate buds stand out in sharp outline, but more beautiful still in spring-time, clothed in the freshest and purest of greens; its shining, deep green foliage and ample shade in summer, and the rich tints of autumn, are also striking features in every landscape.

As we wander through a Beech wood, we soon recognise the fact that this stately tree admits no rival. In congenial soil, where it flourishes in native vigour, not only are the other trees compelled to give way before it, but even the lowly plants cannot thrive in those dense shades. The roots spread horizontally near the surface, and the fallen leaves rot very slowly and cover the soil so that it is kept from being warmed by the sun's rays in the spring-time; this, combined with the density of the growth and the drip from it, renders a Beech wood very different from the luxuriant growth usually found where other trees abound. But although few phanerogams can exist, there are several cryptogams of interest, and for students and lovers of the other kingdom—the birds and the insects—especially invite attention.

The wood of the Beech is hard and brittle; it is useful for tools, various articles of machinery, carpentry, cabinet making, and fuel. It will not bear alternation of moisture and dryness, also if kept too dry no timber is more liable to be moth eaten; but if submerged under water it is said to be very durable. A transverse section shows the distinct appearance of the annual rings. This is due to the closely compressed texture of the late summer and autumn growth: the spring wood contains numerous vessels, but they become smaller and fewer as the season advances. Under the microscope we see that the medullary rays are of two kinds—some being *uni-seriate*, that is consisting of one series of cells; and others, *pluri-seriate*, that is of many: the latter being broad are visible to the naked eye, and therefore form one of the distinctive features of the wood. They widen out as they cross the boundary of the annual rings.

The Beech is a very interesting object for winter study. If we wish to form a true idea of the various forms of the trunk and the disposition of the branches and of the spray, it is the season decidedly the best for our purpose. We find that trees are greatly influenced by their natural surroundings. In general, a detached tree exhibits a trunk clothed with branches almost from the ground upwards, whilst those grown in masses show naked trunks to a considerable height, because the shade from the surrounding trees has cut off the light from them, and the nutritive materials have therefore been directed to the higher branches exposed to the sun and air. In our forests and woods the lofty trunks of the great Beeches rise like polished columns, and as the smooth gray bark catches the sparkling light from the low winter sun most beautiful effects of colour are produced. The slender branches, intertwining with an airy grace, contrast with the massive strength and forked growth of the Oak and the Ash. The lanceolate buds are particularly interesting in winter; they are arranged in an alternate manner on the stem. How wonderful is the packing and arranging of one of these little buds! Formed in the previous summer in the axil of a leaf, this carefully guarded dwelling-place is protected from the winter blasts and all alien influences by the closely imbricated scales. Their colour is very beautiful, red brown in the outside scales, often covered with a delicate bloom; the inner, of a golden brown, shading into green, and of a finer texture, bordered with a few silky hairs. As we carefully remove the scales we notice how securely the young leaves are protected, for the overlapping part is always at the opposite side of the bud to the preceding scale. The four little leaves within are probably larger in proportion to their future size than those of any other British tree. They are delicately fringed and covered with silky hairs, and although they are less than a quarter of an inch in length, yet they are distinctly Beech leaves, showing the plicate arrangement of the vernation, and great beauty and perfection of form.

But it is in the spring-time that our Beech has no rival for beauty. It is generally one of the earliest to put on its summer dress, and the tender green and transparent delicacy of the newly expanded leaves is indescribable. As each little bud expands, and the folded leaves appear from their winter shelter, the outer scales are tossed aside, for their work is done. The soft young leaves have their special duties to fulfil—they must commence their great labour; for in those silent laboratories the food materials for the whole tree are assimilated and combined, to be sent from thence as nourishment to the cambium cells, where active growth is taking place; forming new layers of wood and bast in the roots, trunk, and branches, and new leaves at each growing point. The arrangement of the leaves upon the stem is very regular, and it will be noticed they are placed in the same plane with the branch, and there is no overlapping; the slender stem is also in perfect agreement with the form and size of the leaf.

The flowers of the Beech are not perhaps very noticeable to non-botanists. Yet, in May, if we look under the pale green leaves we cannot fail to see the pendant catkins of the male flowers, with their numerous yellow anthers; and not far away on the same branch the bristly involucres of the future nuts. The ovary is three-celled, but only one ovule is finally developed As the summer days lengthen the Beech leaves become of a darker colour and stronger consistency, and the mast is formed. In the north especially the Beech is often very variable with regard to its fruit. In 1888, the trees were covered with flowers, and afterwards with the nuts, but in 1889 scarcely a flower could be found. This year they seem to be fairly abundant in some districts.

The Beech nuts are usually two together; the fruit is enclosed in a bristly hardened cupule, which has three sharp angles; when ripe it dehisces at the upper extremity, and the nuts drop out. The seed is pendulous; the remains of the undeveloped ovules may be seen at the top. The empty cupules frequently remain on the tree until the following spring; their structure both exterior and interior is worthy of careful attention, showing a wonderful adaptation to the purpose required.

In olden times Beech mast was greatly valued for the fattening of swine, deer, and pigeons, and old writers, such as Gerard, in 1597, and Parkinson, in 1640, say much in praise of it. Even now in some parts of the country as we wander through the Beech woods we find the swine plodding along, and apparently enjoying the fare. On the continent a considerable amount of oil is obtained from the mast, which is very valuable; but our English Beeches do not produce sufficient oil in the mast to render it worth the trouble of extracting.

The Beech, in autumn, is usually a very beautiful object. About the end of September the leaves turn to a glowing orange, or ruddy brown, forming fine combinations of colour with the oak, whose foliage is still green. In some districts the leaves of young trees, or of those growing in a moist or favourable soil, remain on during the winter season.

The early growth of the Beech is an interesting study. About the middle or end of April the wonderful process of germination commences; the nut cracks through the expansion going on within, and the little radicle appears; then the hardened involucre, which has served as a protector for the cotyledons, is thrown off, and they are left tightly folded (Plate XIV., Figs. 4 and 5). But soon they rise erect, their folds are unwrapped, and in May a curious little plant attracts our attention. Certainly to the uninitiated in this early stage of its existence it looks most unlike our idea of a young Beech, for it bears a decidedly fungoid appearance. The cotyledons are raised above the surface; they are orbicular in shape, and folded together, the green or upper side inwards, the outer being of a greenish white colour. In the next stage of growth we find the cotyledons fully expanded, forming two leaf-like expansions very unlike the usual type; between them, small and feeble as yet, we see the future tree (Plate XIV., Figs. 6 to 8). In the later specimens, shown in Figs. 9 and 10, the first pair of leaves has appeared; at this stage the young tree is a most attractive little object, as the yellow green of the young leaves contrasts well with the dark shining green of the cotyledons.

The young seedlings are frequently attacked by the fungoid disease (*Phytophthora omnivora*) known as "damping-off." The subject is most interesting, but it is impossible to do more than glance at it in a limited space. The stem, cotyledons, and leaves become spotted with brown or black patches, and, as the disease is very infectious, it quickly spreads from one seedling to another, and the infected parts shrivel up. It is caused by a fungoid growth in the tissues of the young plant. A section under the microscope shows numerous slender filaments running between the cells: some of these fungus filaments or hyphæ, as they are termed, develop the spores known as the *conidia*. These are so numerous and capable of such rapid germination that every plant in the bed is speedily infected, and also the soil for another season.

A few varieties of Beech are cultivated in Great Britain. Of these the Purple Beech (*F. s. purpurea*) and the Copper Beech (*F. s. cuprea*) are much admired for the striking effects they

Beech mast and early growth of Beech

produce by the contrast of their colour with the surrounding foliage. The Fern, or cut-leaved Beech, is a very variable tree. Sometimes the leaves are in narrow shreds like a fern, and at other times they bear more resemblance to the leaves of a willow. It is variously described as *F. s. heterophylla*, *asplenifolia*, or *laciniata*. The variegated Beech (*F. s. foliis variegatis*) is more uncommon. The leaves are irregularly streaked and marked with white, yellow, or purple. The Weeping Beech (*F. s. pendula*) is known by its pendant branches. The above varieties of *Fagus sylvatica* are propagated almost entirely by grafts.

EXPLANATION OF PLATE XIV.

Fig. 1.—Beech mast dehiscing, showing the two nuts ready to escape from the cupule. The bud for the next season is seen in axil of the leaf.

,, 2.—Beech nut.

,, 3.—Ditto, with the involucre removed, and the suspended seed displayed.

,, 4.—Germination of Beech. The hardened involucre is ready to be thrown off; the folded cotyledons can be seen beneath. The Radicle has appeared.

,, 5.—Showing the folding of the cotyledons.

,, 6.—Cotyledons in a raised position.

,, 7.—Further stage, ready for expansion.

,, 8.—The two leafy cotyledons, and the first appearance of the future growth.

,, 9.—Cotyledons and first pair of leaves.

,, 10.—A young Beech tree.

Colourless Preparations of plants, which usually turn a dark brown on being put into alcohol may be prepared, according to De Vries, by mixing with the alcohol two per cent. of acid, such as hydrochloric. It does not interfere with the microscopic investigation of such specimens, as the acid allows the alcohol to harden the cell walls and contents as usual. Several changes of alcohol may be necessary to remove all the colour.—*Bot. Gaz.*

Dips into my Aquarium.

By the Rev. William Spiers, M.A., F.G.S., F.R.M.S.

Part III.

THE most beautiful of the Rotifers, or wheel-animalcules, are certainly those which are fixed or sessile. These have important home duties to perform, with which the roving life of *Rotifer vulgaris* would be altogether incompatible. Of this group the most common are *Melicerta ringens*, whose wonderful tower of gem-like bricks or pellets every microscopist has gazed upon with delight; *Floscularia ornata*, so well described and beautifully illustrated in Mr. Gosse's "Tenby"; *F. cornuta*, which, like its congener, *F. ornata*, constructs an elegant transparent tube or flask; and *Stephanoceros Eichornii*, the garlanded rotifer.

Familiar as these are to most students of pond life, it is astonishing how much there is yet to discover concerning their habits and modes of existence. Few men have made these creatures a longer or more accurate study than Dr. C. T. Hudson, the present President of the Microscopical Society, and yet in a recent address he remarked concerning *Melicerta ringens*, the commonest of them all: "No one has ever had the patience to watch the animal from its birth to its death; to find out its ordinary length of life, the time that it takes to reach its full growth, the period that elapses between its full growth and death, or, indeed, if there be such a period. And yet even these are points which are well worth the settling. For if *Melicerta* reaches its full growth any considerable time before the termination of its life, it would seem probable that, owing to the constant action of its cilia, it would either raise its tube far above the level of its head, or else be constantly engaged in the absurd performance of making its pellets, and then throwing them away. Who has ever found it in such a condition, or seen it so engaged? Yet, the uninterrupted action of the pellet cup would turn out the six thousand pellets, which form the largest tube that I am acquainted with, in about eight days, while the animal will live nearly three months in a zoophyte trough, and no doubt much longer in its natural condition." Some other points about which we are ignorant in respect to tube-building rotifers are as to whether the eggs are all alike, or whether the sexes of the eggs differ at different times, and as to the characters and habits of the almost unknown male of some species. So that there is enough to be found out even in this well-travelled region to tempt the industry of the adventurous.

Very few who are acquainted with the rotifers will demur to the statement that the most beautiful of the whole group is *Stephanoceros Eichornii* (Fig. 6). I have often fished up this creature, and more than once have had the opportunity of exhibiting it to my friends.

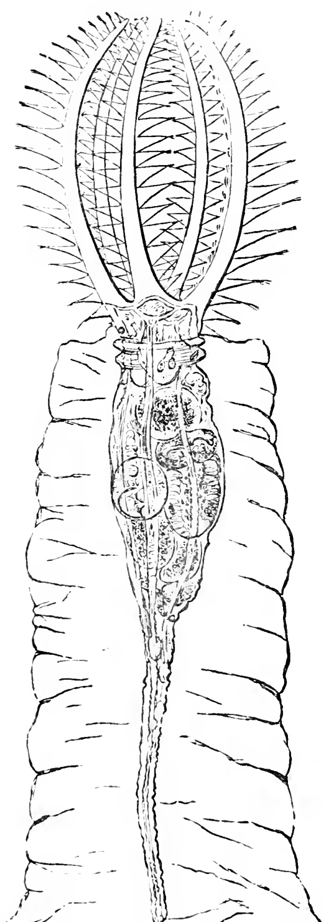

Fig. 6.—*Stephanoceros Eichornii.*

Tubicolar rotifers are not at all difficult to find. Take from the pond a few sprays of water-weed, and examine them in the collecting bottle. If any leaf or twig seems to be dusted, look at it with a pocket lens. To those who are practised in such work the naked eye will be sufficient to detect the presence of rotifers, and the lens will enable the seeker to determine the genus in many cases. The microscope, of course, will be required in order to reveal the details. I have found *Anacharis alsinastrum* the most prolific water plant for rotifers, and it was on this weed that I discovered my first *Stephanoceros*. There was but one solitary specimen, and it was not at first seen. I had kept the weed in my jar several hours before I found it. Several other curious and lovely creatures had disclosed themselves before I became aware that I had captured this queen of rotifers. It was while watching through the lens another rotifer that was swimming about that I detected a tiny oval mass lying in one of the axils of the plant. It soon became evident that it was a totally different creature from the one I had been examining. Although its tentacles were not extended I could see that it was a tube-maker. Knowing the timidity of these tiny animals I turned the stage so as to bring the little stranger directly under observation, and fixed my attention upon it. In due time there came out from the mass five tapering arms, or tentacles, of crescentic shape, and down each side of these slender crescentic horns there soon became visible a number of minute glistening cilia. By means of an oblique light I was able to see the movement of these cilia to perfection, and for the next half-hour I desired no other occupation. Dark-ground illumination also brings out the ciliary action very distinctly. As the creature became accustomed to the altered light the number of its cilia seemed to increase. Its gelatinous case appears to be constructed of rings of unequal size, and partly overlapping, but this may have been an illusion owing to their curvature near the lines of junction. At any rate the whole tube or series of rings are of an exquisite glassy aspect, and the tentacles have quite a pearly lustre. Tiny atoms of food can be seen within the body lying like minute gems, while just below the tentacles are small masses of matter supposed to be nervous ganglia and other organs.

From the books I find that young specimens have a pair of sparkling red eyes, but in the adult these are not discernible. In other characters *Stephanoceros* agrees with rotifers in general, but in respect of its bewitching beauty I know of scarcely anything in the vast assemblage of microscopic objects than can compare with it. It richly deserves its name of the garlanded rotifer, and no possessor of a microscope ought to rest content until he has feasted his eyes with a long look at this living garden of flowers.

The next dip into my aquarium, about which I wish to say something, produced objects not so lovely as *Stephanoceros*, but which are well worth examining on account of their singular form and habit. On the surface of the water, which had not been disturbed for a day or two, I noticed an accumulation of scum. I had brought home the water from a shallow, dirty pond, almost covered with duckweed. I naturally expected to find hydras and diatoms, but it was not these organisms that then first arrested my attention. With the one-inch objective I at once perceived a number of tiny elongated specks swimming about in all directions. I then turned on the quarter-inch, and this enabled me to decide that a crowd of *Euglenæ* had been captured.

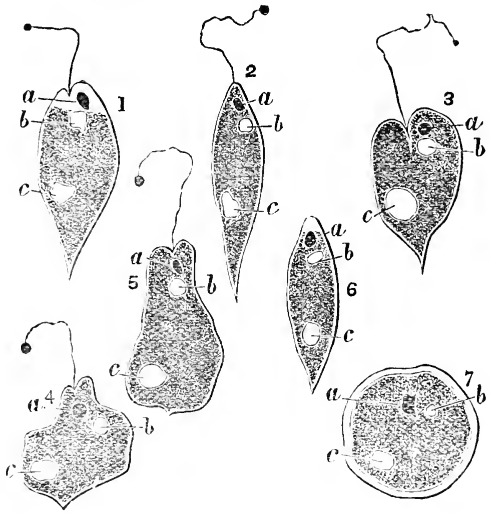

Fig. 7.—*Euglenæ*. *a*, pink spot. *b*, *c*, vacuoles.

Not content with the results I next examined these curious objects with an eighth, giving a magnification of about 600 linear. Then could be seen several long, spindle-shaped organisms flitting to and fro, which had to be compressed somewhat to allow of proper observation. Very pretty they certainly were, notwithstanding the somewhat unsavoury habitat which they seem to prefer. In the anterior portion glittered a tiny pink spot (*a*), uncommonly like an eye, but it is declared by the experts that it is not an organ of vision. Around this spot is a clear space, but the mass of the body is bright green. As it glides along the shape often changes. Now it is long and tapering, anon it bulges out at the top, sometimes it is almost spherical, and occasionally it is contorted and corrugated into forms that admit of no geometrical analogies. All these varieties of shape are illustrated in the accompanying engraving; but it must be understood that every individual assumes all these different appearances by turns. With the higher power it was easy to see also that there was a rather long, delicate tail or flagellum. Occasionally the creature seemed to rest, when it assumed a more or less globular shape, and the tail could no longer be seen.

Anyone looking at these remarkable objects for the first time would probably declare them to be animals. Here are eye, tail and locomotion, and certain specks within the body that look like internal organs of digestion and reproduction. What else can they be but animals? Well, that opens up the question as to what constitutes animality. The old distinctions based on locomotion, the presence of starch, the method of nutrition, and so on, have broken down under the stress of microscopical and chemical examination, and there seems to be no simple and general principle which can be used as a universal criterion. Some go so far as to say that there is no distinction; but perhaps it is safer to say that in regard to the lowliest *protophyta* and *protozoa* the distinction has hitherto eluded discovery. Mr. Gosse decides that *Euglenæ* are animals, and he is no mean authority. But others affirm that they evolve oxygen like plants, while it is clear that they possess the colouring matter of vegetables. Mr. Slack suggests that some of them are plants and others animals, a conclusion which one cannot help feeling is both impotent and useless.

To the popular mind no distinction is easier to make than the one between animals and plants, but the popular mind is concerned mainly with the higher members of these two kingdoms. Science, however, penetrates into an invisible universe, and takes into its reckoning phenomena which are not patent to the unaided eye. Even in the case of a fixed sponge, it is not easy for the tyro to grasp the fact, when told for the first time that he is looking at a colony of animals of a much higher development than many creatures which have mouths, heads, tails, and a digestive apparatus, and that swim about with perfect freedom. And yet there are myriads of animals of lowlier organisation than the sponge, while there are also crowds of minute vegetable organisms which, to the untrained observer, seem much more like animals than does a sponge. Anyone who watches a cluster of monads for the first time under high powers would probably have no difficulty in classifying them, but not so with the man who understands the nature of the problems involved in the question. Let the zoospore of an undoubted plant be placed under the microscope with a monad, and then some indication would be afforded of the difficulty of deciding whether a monad was a plant or an animal. The subtlest analyses of the chemist must be called into requisition in many instances, but even then there would be left some doubtful organisms in which no universal characteristic of either plant or animal could be detected. Substances which, like chlorophyll, the green colouring matter of plants, were long thought to be characteristic of vegetable products, are found to occur in animalcules. Cellulose, of which the walls of plant-cells are built up, is now known to enter into the composition of the outer layer of sea-squirts, while in some vegetables there is actually the digestion of starchy and nitrogenous matters in imitation of animal nutrition. Most animals, it is true, live on organic materials; but so do the Sundew and Venus' Fly-trap, to say nothing of more secret digestive processes like that carried on in the seed of the vetch. The fungus of the tan-pit (*Æthalium*) not only moves about in its earlier stages of development, but even feeds on solids. Then the familiar phenomenon of respiration is not the "fixed quantity" it used to be thought, for, as is now well known, plants which give out oxygen during daylight evolve oxygen in the dark—that is, the vegetable kingdom becomes animal during the night. Moreover, the vast group of fungi do not utilise carbonic acid; but, like typical animals, inhale oxygen both by day and night. There is, then, a scientific *No-man's-land*, wherein dwell things innumerable, which, according to every canon that has yet been tried, cannot be finally arbitrated upon, and which may be called either animal or vegetable.

Of these I prefer to regard *Euglenæ* as forming part, and the differences among naturalists on the point warrant no other conclusion. Prof. Nicholson decribes them under the heading of *Infusoria*, and states that they have an oral opening for the inception of food. He also thinks the red spot may be some kind of sense-organ. But he admits that they occupy a doubtful position.

The reproductive process of *Euglenæ* does not enable us to determine the question. The beginning of this process is marked by considerable changes in the colour and shape of the organism. The bright green colour separates into distinct masses, divided from one another by colourless material. We then have the appearance of a cell-wall containing a tiny green spherical centre or nucleus. After an interval this green nucleus divides into a number of smaller masses, which in due time escape out of the ruptured cell-wall, and become independent individuals. The difficulty of watching the life-history of these extraordinary objects is increased by the fact that the tiny drop of water, in which alone they can be properly studied under high powers, generally evaporates before the cycle is completed. There is here, however, a field worthy of further investigation, and as *Euglenæ* are easily obtained from almost every ditch and stagnant pond, no disciple of the microscope need be long without material for study.

Besides *Euglena viridis*, there are several other species, all very similar. *E. spirogyra*, or the sluggish Euglena, is usually found alone and not in crowds. It is rather larger than *E. viridis*, and not so lively. There are tiny elevations or warts running down the body in lines. When the body contracts, these protuberances present a spiral appearance, and it is this feature which has originated its specific name. Another member of this group is *E. pleuronectes*, which is like a tiny leaflet and is almost flat, the upper side being very slightly convex. The tail is long, and is so colourless that it is necessary to stain the water in order to see it properly. It is almost as common as *E. viridis*, but does not glide along quite so rapidly. Another species is called *E. deses*, and is of solitary habits. None of these are very uncommon, and all would repay thorough and systematic examination.

(*To be continued.*)

Differential Staining of Saccaromyces.—In order to demonstrate the two membranes of the cell of the Fresh plant and similar mycetic growths, Professor S. H. Vines first immerses the growth in a solution of methyl violet, leaving until stained, and, after washing in water, transfers to aniline green. The staining does not in all cases take equally well, but many cells will be found in which the outer membrane is stained green and the inner violet.

Among the Fylde Flowers—The Woodlands.

By William Cross.

> " There lives and works
> A soul in all things, and that soul is God.
> The beauties of the wilderness are His,
> That make so gay the solitary place.
> He sets the bright procession on its way,
> And marshals all the order of the year ;
> And ere one flowering season fades and dies,
> Designs the blooming wonders of the next."
>
> —*Cowper.*

HE who would make his own the secrets of Flora in the Woodlands must commence his rounds of observation early in the springtime, long before

> " . . . Aprille, with his schowres swoote
> The drought of Marche hath perced to the roote."

The first sunny day in February is the best time to begin, just after a general thaw has once again softened the ground.

The Hazel Catkins open their storehouses of pollen in good time, and when the end of March is reached it is often too late to gather the glowing crimson-styled female flowers. The Beech, the Alder, the Poplar, and the Elm also bloom, mostly before the leaves have burst their bud scales. The wind-borne pollen is caught by the stigmas as it is blown to and fro through the naked boughs. If the flowers came after the leaves had grown, pollination could not easily be effected, because the leaves would intercept a large portion.

Not very far from Lytham, in a wood rich in elm, beech, oak, ash, and chestnut; where the rooks noisily attend to their domestic duties high overhead and the mistletoe thrush constructs his bold nest in almost every other tree; where in early springtime the Winter-Aconite and the Snowdrop contest every square inch of surface; where later the changing flowers of the Lungwort are fast outgrown and smothered by terrible crops of nettles; where in many a cosy nook hundreds of lilies hide their fragrant racemes beneath the attendant glossy leaves; where the daffodil flirts with the sunbeams, and where the bluebell, the sweet woodruff, and the woodsorrel at their appointed season clothe the ground with mantles of verdure, gemmed with blossom; there, intermingled with the well-known common ivy, may be found the dark, evergreen kidney-shaped leaves of the Common Asarum (*Asarum europæum*), a plant far from common and not widely known. In this wood, the only locality I know near at hand, the ivy and the Asarum are outwardly so much alike as to deceive any but careful observers. The leaves of the Asarum grow in pairs on rather long stalks, and are about two-and-a half inches broad. They spring from very short, procumbent stems. Between them, in the month of May, may be found the peculiar greenish-brown flower, about half-an-inch long, on a short stalk, a flower so inconspicuous as not to easily attract attention, even when handled. Tradition tells us that the plant was rejected from the garlands used by the ancients, and certainly its name lends support to the story, because it is derived from the Greek *a*, not; and *Sairo*, I adorn. It belongs to the natural order, *Aristolochiæ*, and is the only British representative of that family. It is confined to a few northern localities, where thick-set trees afford congenial shade.

Hard by is a pond whose denizens deserve a passing mention. Conspicuous among the foliage of the bulrush and the bur reed are the stout, tall, leafless flower-stems of the Common Butome or Flowering Rush (*Butomus umbellatus*), a noble member of the natural order, *Alismaceæ*, which contributes so largely to the adornment of British ponds and ditches. This stalk is surmounted by an umbel, thirty to forty strong, of rose-tinted six-petalled flowers, each about an inch in diameter. This is another uncommon plant for the northern counties. It blooms from June to August, and often reaches a height of over four feet. The leaves are also very long and erect, are triangular in shape, and are somewhat sharp to the touch, which characteristic receives recognition in the name Butomus, from Greek *Bous*, ox, and *temno*, I cut, because the mouths of browsing cattle are likely to be injured.

Butomus is well supported by its kinsmen, the Water Plantains, both the greater and the lesser occupying the same pond. These two plants are very abundant in the Fylde—the former especially so; hardly a pond to be found anywhere which lacks a good stock of specimens.

The margins of woods are generally fringed with an astonishing array of plants, and must be visited time after time if every species is to be noted. In the Fylde it is no uncommon sight to find the fences crowded with the Woody Nightshade (*Solanum dulcamara*), while just behind tall Umbellifers are set off by the deep shades behind. Here, too, may be found the Common Valerian (*Valeriana officinalis*); the showy masses of the Great Hairy Willow Herb (*Epilobium hirsutum*), whose flowers make the ditch so attractive in July and August; here, also, an occasional specimen of the Common Meadow Rue (*Thalictrum flavum*) may be seen, which has struggled through briar, thorn, and bramble, and now proudly rears its pale yellow, pollen-laden inflorescence high above all obstacles.

Many woods are flanked by wide moats over knee-deep in water, as a short jump only too surely proves. In these the yellow water-lily holds its own, sheltered by banks thronged with vetches and trefoils. Here flourishes the reed, intermingled with the smooth horsetail, screening from the passer-by the deftly-woven ark of the water hen, on which she sits alert to the slightest approach of danger. Here may be found that handsome member of the primrose family, the so-called water violet (*Hottonia palustris*), a welcome find to any flower-lover. Within two miles of Lytham station, ditches may be visited which are apparently monopolised by this lovely plant, the surface of the water being entirely concealed, as with a huge sheet, by the yellow-eyed lilac blossoms, so thickly do the plants grow together. The leaves, which are submerged and much divided, form a dense tangle, in which many species of fresh water molluscs domicile themselves. This lovely plant is seen in its maximum of splendour about the end of May. It is often associated with a great deal of the cuckoo flower (*Cardamine pratensis*), and as the petal-colours in both plants are almost identical, at a distance of a few yards it is almost impossible to distinguish either species from the other.

And here may be found the celery-leaved Buttercup (*R. sceleratus*); the spiked Water Milfoil (*Myriophyllum verticillatum*, Gr., *myrias*, myriad, and *phyllon*, leaf), so called because of its many leaves; the vernal Water Star-wort (*Callitriche verna*, Gr., *Kallos*, beautiful, and *triche*, hair), with its long and slender hair-like stems, the little incomplete flowers of which, as they peep above the floating leaves, remind you of the Marestail, described some time ago, and the resemblance is quite orthodox for both plants, and the Milfoil, too, belong to the same Natural Order (*Haloragiaceæ*).

Many other plants dwell here besides those honoured with special mention, but space only permits a notice of the most prominent species.

In a sheltered nook of another favourite wood, in which all the plants mentioned in the former part of this paper flourish, two other plants of considerable interest may be found. The first inhabits a deep pond, the margins of which are fringed at least a yard wide by fine sedges, veronicas, forget-me-nots, and other moisture-loving plants. It is the Greater Bladder-wort (*Utricularia vulgaris*), and its yellow flowers make quite a gay contrast in July and August as they tower erect above the floating dark leaves of the broad-leaved Pondweed (*Potamogeton natans*), which underlie them. The numerous bladders which are sessile on the submerged leaves are now known to be cunningly devised traps for small water-fleas and other creatures of similar size, but formerly they were looked upon only as special contrivances for floating the leaves during flowering time. The Natural Order which it represents, viz., the *Lentibulariaceæ*, is rich in carnivorous plants; the Common Butterwort (*Pinguicula vulgaris*), so abundant in northern bogs, being perhaps known more widely than the rest.

The second, a plant which I wish especially to note as belonging to the Fylde Flora, is the Solid-rooted Corydalis (*Corydalis solida*). This plant is not indigenous, but has established itself at Lytham and at Wrea Green. The root is tuberous, as the specific name indicates. The crowded purple flowers in terminal racemes and the smooth, prettily divided leaves are very attractive, and in these characteristics it is easily recognised as a relative of the common Fumitory (*Fumaria officinalis*), which throngs our Fylde cornfields no less thickly than elsewhere.

Apropos of this plant, may the incident now to be recorded warn lovers of flowers to be exceedingly reticent as to the whereabouts of any which have the misfortune to be reputed rare, as the information may be acted upon in a manner calculated to afford painful themes for after-reflection.

Last spring I was specially requested to show an acquaintance the habitat of this plant, and full of good faith set out to do so. On our way we passed a pretty clump of the Nodding Star of Bethlehem. The Corydalis was in good show, was very much admired, and the unselfish visitor was apparently thankful to pull a couple of specimens.

A fortnight later, to my intense regret and disgust, I found that the entire lot of plants had been—not pulled only—but actually dug up root and all.

With feelings of alarm I hurried to the place where we had stood and admired the lovely Ornithogalum. Every flower had disappeared, and evidences that the trowel had done its work were not lacking. I subsequently learnt that my acquaintance was busy seeking adequate exchanges for dried specimens of both plants. "Once bitten, twice shy," is now ineradicably engraved on my mind for evermore.

June is a capital month to work at many of the British Natural Orders. Grasses especially should be hunted up, as they are then at their best, but that of course is chiefly meadow work, although many species can only be found in the woodlands.

However, the members of one family, to wit, the *Rosaceæ*, bear at this time a large share in sylvan adornment. I have for a minute or two been pencilling the names of all the Rosaceous plants which could be seen on any June day in the Lytham woods. The list is interesting and fairly representative of the family, comprising as it does nearly twenty species.

First comes the Sloe or Blackthorn (*Prunus spinosa*), which, though it flowered late in March, is too attractive to be passed by for it is in full leaf and heavily fruit-laden.

The Crab-apple (*Pyrus malus*), the Mountain Ash (*Pyrus aucuparia*), and the Hawthorn are still in flower, although their finest blooms were cast before the end of May, but beneath these what an array of brightly decked kinsmen. One can wade shoulder deep through solid squares of Meadowsweet (*Spiræa ulmaria*), which burden the air with their powerful fragrance, the same perfume which is produced by the Hawthorn, but, thickly though they grow, the ground below has other no less attractive evidences of its fertility, for, if the Strawberry is not busy flowering with all its might, you are sure to find either the Silver Weed (*Potentilla anserina*), or the Wood Avens (*Geum urbanum*), lit up with beautiful yellow flowers.

The list is yet incomplete. We must add the Bramble, the Raspberry, and other Rubi, and certainly must not forget the bushes, streamers, and climbers of the two Wild Roses—(*Rosa canina*) and (*Rosa arvensis*). On the inside of the hedge which runs round the wood is a ditch with a sloping bank, and in it grows the purple Marsh Cinque-foil (*Comarum palustre*), with beautiful leaves and rich purple-back flowers. On the sloping bank the Lady's Mantle (*Alchemilla vulgaris*) and the Creeping Cinque-foil (*Potentilla reptans*) are grasping all possible territory, while if you stand astride the ditch and peep over into the corn-field beyond, the Parsley-Piert or Field Lady's Mantle (*Alchemilla arvensis*) may be discerned in between the drill lines. The Tormentil (*Potentilla tormentilla*) and the Agrimony (*Agrimonia Eupatoria*) live within a stone's throw, completing an attractive family array.

I omitted in the foregoing paragraph the botanical name, *Cratægus Oxyacantha*, which appertains to our old acquaintance, the hawthorn, for its appearance to the novice is perhaps somewhat startling, and the reading of it does not much improve one's early impression, but, like most names of ancient derivation, it will bear critical examination. The generic name *Cratægus* is obtained from *Kratos*, a Greek word signifying strength, because the timber of the hawthorn is exceedingly hard. The specific name *Oxyacantha* is derived from the same language as its chief; *oxys*, meaning sharp, and *akantha*, a thorn. It is a fact, which all beginners in the study of Elementary Botany should know, that the majority of wild plants have equally sensible botanical names.

(*To be continued.*)

Pencil for Writing on Glass.—Melt together 3 parts spermaceti, 3 parts of talc, and 2 parts of wax, and when melted stir in 6 parts of minium and 1 part of caustic potash. Continue the heat for thirty minutes, when it is ready to be cast into forms of glass tubing. After cooling the crayon can be pushed out. Preserve in wooden boxes.

Aspect of the Heavens: July, August, September, 1890.

By A. Graham, M.A., etc., Cambridge Observatory.

THE *Sun* will be in *Apogee*, or at his greatest distance from the earth, on July 3rd at 6 in the morning, more than three millions of miles further away from us than he was on the morning of January 2nd, when in *Perigee*. *New Moon* occurs on July 17 at 0*h.* 50*m.* in the morning, August 15 at 4*h.* 20*m.* aft. and September 14 at 7*h.* 53*m.* morn.; *Full Moon* on July 2 at 2*h.* 23*m.* aft., July 31 at 9*h.* 24*m.* aft., August 30 at 4*h.* 35*m.* morn., and September 28 at 1*h.* 0*m.* aft.; *First Quarter*, July 25 at 2*h.* 44*m.* morn., August 23 at 1*h.* 20*m.* aft., and September 22 at 10*h.* 6*m.* aft.; *Last Quarter*, July 9 at 4*h.* 43*m.* morn, August 7 at 2*h* 19*m.* aft., and September 6 at 3*h.* 30*m.* morn.

She will be nearest to the earth on July 3 at 3*h.* aft., July 31 at 11*h.* aft., August 29 at 9*h.* morn, and September 26 at 4*h.* aft.; farthest from the earth on July 18 at 1*h.* aft., August 14 at 4*h.* aft., and September 10 at 11*h.* aft.

She will be in conjunction with *Mercury* on July 16, August 17, and September 15; with *Venus* on July 20, August 19, and September 18; with *Mars* on July 27, August 24, and September 21; with *Jupiter* on July 4, July 31, August 28, and September 24; and with *Saturn* on July 20, August 16, and September 13.

A remarkably close conjunction of *Venus* and *Saturn* occurs on July 17 at 5 in the afternoon, when the angular distance of the centres will be only 6 minutes of arc. The planets will be above our horizon, 2*h.* 24*m.* west of the meridian, and *Venus* at least may be easily seen with a telescope.

Mercury and *Saturn* will be in conjunction on the morning of August 10; and *Venus* will be in conjunction with *Uranus* on September 2.

Mercury will be in superior conjunction with the Sun on July 22, and in inferior conjunction on September 29. On September 3 this planet will be at its greatest angular distance from the Sun, 27 degrees eastward, and may possibly be seen about that time as a morning star.

Venus is very conspicuous as an evening star. Seen through a telescope the form is gibbous till September 24th, the time of its greatest elongation from the Sun; after that it takes the crescent form, gradually diminishing in width but increasing in diameter as it approaches the Sun.

Mars is visible throughout the evening, low in the south and south-west. It will be in conjunction with Antares, the bright red star in Scorpio, at a distance of about a degree and a half, on August 24. The planet will be northward of the star. A comparison of these two objects in such close proximity will be interesting even with the naked eye, but much more so with the telescope.

Jupiter will be in opposition to the Sun on July 30, and, of course, crosses the meridian about midnight. It is very conspicuous, though rather low—the meridian altitude at Greenwich is only 19 degrees.

Saturn is approaching the Sun. It will be visible as an evening star till the end of July; after that it will soon be lost in the twilight. On August 30 it will be in conjunction with the Sun.

Uranus is an evening star.

Neptune is a morning star, not far from *Albebaran.*

The Sun crosses the Equator southward on Sep. 23rd at 2 in the morning, and the Autumn Quarter commences.

Paste for Mounting Botanical Specimens.—The following is used by the collectors for the Smithsonian Institute and for other large institutions in the United States and in Europe:—Tragacanth in powder, 30 parts; Gum Arabic in powder, 20 parts; Glycerine, 30 parts; Water, 60 parts; Bichloride of Mercury, 1 part; Boiling Water, 240 parts. Mix the gums with the glycerine and water in a mortar with vigorous stirring. Dissolve the Bichloride in the boiling water and add the solution to the mixture. When cold a few drops of oil of cloves may be added. —*Nat. Drug., 1889, p. 209.*

The Pine Destroyer (*Hylurgus piniperda*).

By the Rev Hilderic Friend, F.L.S., Carlisle.

Part 2.

Historical.

We will now turn our attention to the history of the particular genus and species under review. In almost all researches of this kind one is continually being baffled and confused by the multitude of different names which, at various times, have been applied to the creatures under investigation. This difficulty, of course, arises from two principal causes. In the first place, the writer of a description may suppose that he is pourtraying characters for the first time, and as he is not aware that his insect has previously been studied, described, and named, he at once manufactures a designation which seems to him, for some reason or other, suited to the same. Hence, many synonyms arise, each of which has a claim to recognition. In course of time, however, when knowledge increases, classification becomes necessary, and comprehensive general terms must be invented which will bring together similar forms of life from many quarters, and bearing many different names. As different methods of classification are adopted different names are employed, and thus a further multiplication of terms ensues. The consequence is that in many cases modern writers are compelled to quote the synonymous designations by which the subject of their discourse is known among men of science, just as the police use the alias of certain bipeds which periodically pass through their hands. There are some objects in nature whose position, operations, economy, or appearance are so striking that a name seems to suggest itself immediately on examination. There are others in which these points are so obscure that a fertile imagination is needed to define them.

In the case of the tiny beetle about which we are at present concerned there is no obscurity. Its habits are easily understood, and, as a consequence, the names which have been applied to it usually set forth with sufficient clearness its leading characteristics. There are no fewer than six specific names for this insect in the works of entomologists, which we will take in chronological order. Linnæus comes first (for we do not need to go further into antiquity), and with him the genus is known as *Dermestes*, a compound of δερμα, skin or hide, and ἐσθίω, to eat; because the various species were known to feed upon skins, feathers, hair, hides, and other similar substances. The name Dermestes is still retained, and applied to a small group of beetles, of which the best known perhaps is *Dermestes lardarius*—the Bacon Beetle.

Following close upon the heels of Linnæus comes De Geer, whose "Insect Memoirs" began to appear in 1752.* He wrote seven quarto volumes on the history of insect life, and designated our beetle Ips, from the fact that by the ancients a worm or insect that feed on horn, wood, or other hard material was so named (ἴψ, ἰψός). De Geer's name is adopted by Marsham, who, in 1802, wrote a book on British Entomology, the first volume of which deals with Coleoptera. In 1775 Fabricius published the first edition of his "System of Entomology,† and to him we owe two separate terms. The first, Hylêsinus, is from the Greek ὕλη (or Hylē), woody material, and σίνος, anything hurtful, a plague (σινομαι, to ravage or devour), and means the wood-plague, or destroyer of timber. The second is Bostrichus, whence the name of the family—Bostricidæ. The name Hylêsinus is still employed by some entomologists, especially on the Continent. At the end of the last century, when insect life was engaging a goodly share of scientific attention, Olivier undertook to write on the natural history of insects, and treated especially of the Coleoptera.‡ He adopted the generic title, *Scolytus*, in which he was followed by his contemporary, Latreille. This term, still in use to designate certain species of wood-eating beetles, was intended to refer to the tortuous tracks made by the insects on the wood which they were devouring (from the Greek, σκολιος, crooked, winding).

Finally, as though the creature had not already received sufficient names, Leach, writing between 1814 and 1820, adopted

* *Memoires pour servir a l'histoire des Insectes*, by C. De Geer.

† Systema Entomologiæ, etc.

‡ *Entomologie: ou Histoire Naturelle des Insectes.*

the name *Hylurgus*, a name which Latreille had already employed in the earlier years of this century. This term means simply a carpenter, woodman, or worker in wood (from the Greek substantive, ὑλουργος), and, while scarcely as expressive as *Hylêsinus* when applied to our particular species, it is a good designation for the genus as a whole.

With reference to the trivial name there has never been any difficulty so far as I can learn. The insect was called *Dermestes piniperda* by Linnæus; it is called *Hylurgus piniperda* or *Hylêsinus piniperda* to-day, and the reference to its destructive operations among the pine trees is sufficient explanation of the persistency of the epithet.

Habits and Economy.

We are now in a position to consider the habits of this destructive insect and make some enquiries into its economy. When we remember that the Coleoptera, as a whole, are Nature's scavengers and undertakers, removing animal and vegetable matter which is in danger of breeding putrefaction and disease, we shall not be too hasty in our conclusions respecting those species which *seem* at first sight to be inimical to human interests. No doubt many insects are at present rightly regarded as *pests* and enemies to mankind, but it is always found that when their mission in Nature is properly understood they have a place to fill, which is usually of great importance; and all we need to know is how to obey the laws of Nature so as to make all her thousand busy workers subserve the highest interests of man in the fullest degree.

First, then, we know that the female beetle deposits her eggs under the bark of timber which has been felled by the woodman or the storm. Here, in due course, the eggs are hatched, and the grubs begin their work. Evidently their mission is to clear the forest of dead and waste material by letting the light, air, and moisture into the timber. Having worked and tunnelled far and wide, it by and bye changes into the pupa stage, and when the pupa emerges the bark of the tree will be found loose and hollow. The bark now readily falls off, and the atmospheric, fungoid, and other agencies soon cause the timber to decompose. Clearly, then, the moral is, leave no pine trees lying all the year round in the plantations. Take them away to the timber-yard, strip off the bark, and burn it, and keep the wood dry. Very often when I have been exploring pine forests for plants, fungi, and insects, I have come across tree after tree which has fallen or been felled, but has never been removed from the ground, and five minutes' examination has revealed whole colonies of most interesting but industrious creatures in various stages of development, each doing its own work, and in many instances preparing for a period when it would, by force of numbers, or altered form and locality, do incalculable harm. Had the fallen tree been removed or utilised, no need for the services of these humble but useful creatures would have arisen, and no nidus or breeding place for more destructive forms would have been provided.

When, however, the young beetle emerges from the dead log it has taken on a new form of existence, and new modes of life. And here it is that the importance of our study begins to appear. There are some who maintain that the habits of the pine destroyer are merely saprophytic, not parasitic. Dr. Chapman writes to the following effect—" I determined with regard to this species and *Scolytus destructor* that they only attacked dead or sickly trees. A sound tree throws out so much sap (in the pines, resinous) that the beetle makes no progress. I have seen sickly elms that might perchance have recovered, destroyed by *Scolytus*, and it is conceivable that attack might be made in such force as to exhaust the available sap, but I know of no such instance." In order to determine this point I have made several excursions to pine plantations in different parts of Cumberland, with the following results :—1.—I find that Hylurgus lives under the bark of dead and decaying trees, where it makes a series of tunnels or galleries, as figured in Miss Ormerod's *Manual*. Near the country inn, usually known as the Red Cat, near Carlisle, I examined some trees which had been thrown down, and found them full of larvæ and dead beetles. 2.—I also find that the beetles settle on the young trees in the plantations (as well as on the old sturdy trees with a good sound trunk), eating their way into the very centre of the leading shoots, which, in a short time, become so weakened that any little squall or storm will cause them to snap asunder and fall. That these trees are in good health may be shown in many ways. Many of the shoots, for example, have produced perfect cones, which show that the vigour of the tree is unabated. Their tissues are healthy, the bark is uninjured, new year's growths abound, and there is every appearance of vitality and development. So far from being afraid of the resin the beetles seem, when attacking living trees, to make specially for the newest shoots, entering the branches near their extremities, and penetrating right into the growing bud, despite the flow of resinous sap. My experience permits me fully to endorse the notes on the economy of Hylurgus, given in Miss Ormerod's *Manual*—"In their first stage—that is, whilst they are still feeding as maggots—they do little harm, this part of their life being rarely passed in healthy trees; it is after they are developed that the real work of destruction begins. Then they pierce a little round hole through the bark at the end of their burrow, come out through it, and fly to the neighbouring trees, where they may be found (during autumn) in great numbers, boring into the young shoots," and doing them great injury. Mr. Lindley, who supplied Curtis with the material employed for describing this insect in his *British Entomology*, thus writes respecting his own researches:—"For the purpose of observing its proceedings more narrowly I placed a shoot of the Scotch Fir under a glass with the insect. In about three hours after it had just begun to pierce the bark at the base of one of the leaves; its mandibles seemed chiefly employed, its legs (the tibiæ of which are provided with very strong spinous projections to enable it to press securely downwards) being merely used as a means of fixing itself more firmly. Four hours after its head and thorax were completely buried in the shoot, and it had thrown out a quantity of wood which it had reduced to powder, and which nearly covered the bottom of the glass. In sixteen hours more it was entirely concealed, and was beginning to form its perpendicular excavation," etc. When the insects are disturbed in their tunnels they are usually sluggish or dazed, and I have never seen them attempt to fly when opened out. They rather endeavour to conceal themselves by running into their burrows, or hiding from view. As the young shoots fall to the ground they bring with them the beetles which are lodged within, and during the winter the insects hibernate in these shoots, in the moss and undergrowth on the ground, or in the crannies of bark, decayed trees, and similar places, where they await the period of oviposition.

Nature fortunately knows how to maintain a just balance, and I have found the young plantations where Hylurgus abounds visited by numerous small birds, which flit from branch to branch, and tree to tree, picking off every stray beetle that allows its face to be seen outside its tunnel!

From all that we have gathered during this study, it seems clear that the following deductions can be made:—1.—The insect is equally at home among standing and fallen timber. 2.—That dead trees should never be allowed to remain in plantations where it is desirable to get rid of the pest. 3.—That all shoots which have been blown off, or have fallen by their own weight, or give evidence of being damaged by the beetle, should be collected and burnt. 4.—That no beetle-eating bird should be destroyed in the neighbourhood of pine forests; and lastly, that all toppings, dressings, and other loose material, should be cleared from the ground in summer or autumn, that they may not serve as nidus for the fertilised female.

In conclusion, if asked by the critic or utilitarian what can justify the expenditure of so much time in the study of insects so minute, I reply, that it is not only the privilege, but the duty of the trained investigator to aid his fellows, who have to battle against the ravages of enemies about whose secret ways they know nothing. The empirical knowledge of the gardener and forester needs supplementing and correcting, and the man of science is often the only person who is able to do this. And, when we remember that abroad as well as at home, immense damage has been done to pine forests by these creatures; it is surely worth our while to spend a few hours in the study of what may prove an appalling calamity. Priests have again and again implored the Divine clemency to put an end to the devastations made by these destructive agents, and the answer they have received is, in effect, Nature is subject to laws—learn them, obey them, and live. I would not mock the Great Ruler of the Universe by praying to Him to remove a calamity which could be averted by the exercise of common sense, and the use of my powers of observation, neither am I justified in blaming God for sending troubles which it is in my power to avert; and for this reason, I feel not only justified in pursuing such studies into the laws of life, but urged thereto. Nor is this all. No single creature, whose life-history we can trace, will pass through the hands and under the eye of the intelligent observer, without teaching him many an interesting and profound lesson. Beauty and delicacy of design and workmanship; marvellous adaptations of organs to uses, of means to ends; wise provisions for balancing the forces of nature; beautiful play between vegetable and animal life, these are a few of the more obvious lessons which the study of biology teaches us.

I place this humble contribution to the sum of human knowledge before our readers, in the hope that it may prove a stimulus and an encouragement to all who have a little leisure to follow out some similar course of original research for themselves; assured that nothing is more healthful or pleasant either for body or mind.

Literature.

It is to be feared that the practical student of this subject will find little in the English language to help him. The early authorities on insects were all foreigners, and wrote in Latin French, or German. The first English study of the subject with which I am familiar is by Curtis, in his now rare and costly work on *British Entomology*, where we find (Vol. III., pl. 104) a plate and two pages of letter-press describing the insect and its method of working, but no reference to its immature stages of development. In the volume on Beetles in *The Naturalists' Library* not a word is said about any of the species of Hylurgus under any of their synonyms, and until 1868 their life-history was practically unknown. After Dr. Chapman's researches more attention was paid to injurious insects, and in 1879 Miss Ormerod gave some account of our beetle in her "Report of Observations on Injurious Insects," which was followed in 1881 by her valuable "Manual of Injurious Insects," where we have a considerable amount of information. Figures of the insect occur in Curtis, in Miss Ormerod's *Manual*, and in Figuier's "Insect World." Among foreign works we may mention the *Systema Naturæ*, of Linnæus, 2,562,9; Fabricius' *Ent. Syst.*, Vol. 1., p. 2, page 367, n. 17; Mars. *Ent. Br.*, 57, 18.

Wesley Naturalists' Society.

THE Triennial Election of Officers has just taken place with the following results :—

President : Rev. Hilderic Friend, F.L.S., Carlisle.

Vice-Presidents: Dr. Kimmins, Downing Coll., Cambridge.
Rev. G. Stringer Rowe, Headingley Coll.
John Potts, Esq., F.G S., F.R.M.S., Macclesfield.
G. Swainson, Esq., F.L.S., Bolton.

Council : J. Beauchamp, Esq., London.
Rev. W. T. Davison, M.A., Richmond Coll.
Miss Kate Hessell, Queenswood Coll.
J. B. Bessell, Esq., Bristol.
Rev. A. S. Geden, M.A., Leeds.
F. W. Sutcliffe, Esq., F.R.M.S., Oldham.
J. F. Stead, Esq., J.P., Southport.
Rev. W. E. Codling, F.R.M.S., Leeds.
M. E. Swan, Esq., London.
T. D. Wright, Esq., Lancaster.
Rev. S. J. P. Dunman, Cardiff.
Rev. C. Crawshaw, Bradford.

Secretaries : Rev. W. Spiers, M.A., F.G.S., &c.
Dr. Bousfield.

The Annual Meeting and President's Address will take place in London in the Autumn, particulars of which will be given in our next. No definite arrangements have yet been made for the Annual Excursion.

Reviews.

THE HISTORY OF MEXICO. By Hubert Howe Bancroft. Vol. II. 8vo, pp.xiv.—790. (San Francisco : The History Publishing Co., London : Trubner & Co.)

This is one of the series of works by Mr. H. H. Bancroft, the great American historian. It contains the history of Mexico between the years 1521 and 1600, and relates the doings of Cortés and his companions after the conquest ; the coldness of the king and the attitude of the viceroys are discussed. An account is also given of ecclesiastical affairs and the spread of colonisation.

A History of Bridgwater. By Sydney G. Jarman. 8vo, pp. 284. (London: E. Stock. St. Ives: Jarman and Gregory. 1889.)

An interesting history of a very interesting old town. It commences with a description of what the locality is supposed to have been at the time when Cæsar brought his fleet to our shores, about 55 B.C., and continues the history up to the present date. There are some good illustrations, and the book will be found to be of more than local interest.

The Annals of the Parish of Swainswick. By R. E. M. Peach. Crown 4to, pp. xi.—183. (London: Sampson Low, Marston and Co. Bath: Charles Hallett.)

Mr. Peach, who is the author of "Rambles about Bath," "Historic Houses of Bath," and of several other works of local interest, has compiled the work before us in a great measure from parochial documents. These records show us very forcibly the great contrast between the past and the present, and induce us to think that few would now care to go back to the "good old times."

The book is handsomely got up, and of much local and antiquarian interest.

A History of Cumberland. By Richard S. Ferguson, M.A., LL.M., J.S.A., etc. 8vo, pp. viii.—312. (London: Elliot Stock. 1890.)

The writer of this interesting volume had consulted all the literature relating to Cumberland that he could obtain access to, and in a condensed form has given us the result of his studies, which we are sure readers will find most interesting. In the various chapters he treats of The early inhabitants, The Roman conquest, Roman roads, ports, and towns, etc., etc. At the end of the book, a classified list of books, etc., relating to Cumberland is given.

The History of California. By Hubert Howe Bancroft. Vol. V. 8vo, pp. xv.—784. (San Francisco: The History Publishing Co. London: Trubner and Co.)

This volume treats of the history of California for three or four years, from 1845 to 1848, and describes the conquest of California and the military occupation by the United States; Larkins' effort for peaceful conquest; Fremont's operations; Bear Flag revolt; occupation by the U.S. forces; the revolt in the South; and the operations of Stockton and Kearney.

The Uncrowded Atlas.
Bible Atlas. (London: Ruddiman, Johnston, and Co.)

Two useful little atlases, published at sixpence each. In the Uncrowded Atlas the author gives only a few of the most important names in each country, or county, as the case may be, and these are printed in good bold type.

In the Western Highlands of Scotland. By Percy T. Cowley. Cr. 8vo, pp. iv.—85. (London: E. W. Allen. 1890.) Price 1s.

A pleasantly written account of what was doubtless a very pleasant trip to the Highlands of Scotland. The author also relates a short account of a Holiday at Scarborough.

Stanley in Tropical Africa. By Ronald Smith. Cr. 8vo., pp. viii.—196. (London: Ward, Lock, and Co. 1890.) Price 1s.

We have here a most readable account of Mr. Stanley's work in Africa, and the leading features of his four expeditions in that land. The interest, of course, centres in the last expedition to relieve Emin Pasha, and this book will be found to be most useful for those who may not have the leisure to read the full account which Mr. Stanley is about to publish. The book is well illustrated.

THE SABBATH FOR MAN: An Inquiry into the Origin and History of the Sabbath Institution. By the Rev. W. Spiers, M.A., F.G.S., F.R.M.S., etc. Cr. 8vo, pp. xii., 218. (London: C. H. Kelly. 1890.)

This is a book written 'to order,' but unlike the majority of such it breathes throughout the spirit of intense earnestness, and strong, enlightened, personal conviction. It is the first of three prize essays, written for 'The Lord's Day Observance Committee of the Wesleyan Methodist Conference'; and, after a careful perusal, we are not surprised to learn that of the essays sent in, it was deemed by the adjudicators "beyond all question the best." The contention of the writer—a contention ably sustained by *à priori* reasoning, historical evidence, and keen criticism of opposing theories—is that the institution is to be traced to the very beginning of human history—being made 'for man,' it is as old as man—that it embodies an immutable principle of moral and necessary law; that its secularisation, from whatever motives, is injurious to the intellectual, moral and physical life of man; whilst, if jealously observed in the spirit of the New Testament, accepted as a Divinely-given opportunity for religious instruction, worship and service, it is a safeguard of religion, a bond of human brotherhood, and a foundation of national greatness.

We cordially commend the book as a clear, concise, and able description of the origin, history, and authority of the Sabbath Institution.

A POPULAR TREATISE ON THE WINDS. By William Ferrel, M.A., Ph.D. 8vo., pp. vii.—505. (New York: John Wiley and Sons. 1890.)

The subject matter contained in this work is, we are told, an expansion of a series of lectures delivered to a class of army officers in the U.S.A. Signal Service. They embrace such subjects as The Constitution, Nature, and general Circulation of the Atmosphere; Monsoons, and Land and Sea Breezes; Cyclones; Tornadoes; Thunderstorms, etc. A thorough knowledge of these will doubtless be of great advantage to all who are desirous of understanding the observed phenomena and sequences of the weather, and of forming rules for weather predictions.

A MOVEABLE ATLAS OF THE HUMAN BODY. By Prof. G. J. Witkowski, M.D. (London: Bailliere, Tindall and Cox.) Price 7s. 6d.

Such an atlas as this is invaluable to the medical student. It contains the neck and trunk of the human body, and by means of a number of superposed coloured plates, shows the position of all the internal organs. These organs are numbered up to 190. The text is translated into English by Robert Hunter Semple, M.D., F.R.C.P. London.

APPLIED ANATOMY: Surgical, Medical, and Operatic. By John M'Lachlan, M.D., B.Sc., M.R.C.S., etc. 2 Vols. Cr. 8vo., pp. xvi.—584 + xii.—584. (Edinburgh: E. and S. Livingstone. 1889.) Price 10s. 6d. each.

A third edition of this important work has just reached us. We believe it will render very efficient aid to students about to pass the higher or final examinations, more especially for those which require actual operations to be made on the dead body. The instructions given are very thorough and carefully expressed. We notice that much new matter has been added in this edition, especially in the parts treating of Medical Anatomy. A large number of new illustrations have also been added, and they now number two hundred and thirty-eight.

Nerves of the Human Body, with Diagrams. By Alfred W. Hughes. 4to. (Edinburgh : E. and S. Livingstone. 1890.)

Students of Medicine will, we feel sure, find much assistance from the study of this book. The nerves are beautifully drawn (and many of them coloured) on 10 plates, some being double size. The letter-press descriptions are clear and concise, and will be found to contain all that is necessary for the purposes of examination. The whole work is beautifully got up.

A Hand-Book of Dermatology. By A. H. Ohmann Dumesnil, A.M., M.D. 12mo., pp. viii.—167. (St. Louis, U.S.A. : Medical and Surgical Journal Pub. Co.)

This little book is written for the use of students, and treats more particularly on the broader principles of the Science. It has 34 illustrations, and a large amount of information is contained in a small space.

The Healing Art, and the Claims of Vivisection. By Edward Berdoe, M.R.C.S., L.R.C.P. (London : Swan Sonnenschein and Co. 1890.) Price 1s.

In this little work of 50 pages we have a lecture delivered at Cambridge on March 10th last. The writer expresses himself exceeding strongly against vivisection; but, of course, only one side of the question is given. We should like to hear the other side argued, when, doubtless, our verdict would be: there is something to be said on both sides.

An Account of the Manners and Customs of the Modern Egyptians, written during the years 1833-35. By Edward W. Lane. Crown 8vo, pp. xxiv.—552. (London : Ward and Lock. 1890.)

This is one of the "Minerva Library of famous books," and well deserves a place in such a series. It is needless to say anything in praise of a book which may be called an English classic, and which after being before the public for 50 years, is still regarded as an authority upon the subject. The thorough impartiality and consequent truthfulness of the author, is one of the many charms of the book. The present edition is enriched with 80 illustrations and 16 full-page engravings ; it also contains a Biographical notice of the author.

The Origin of the Aryans. An account of the Prehistoric Ethnology and Civilisation of Europe. By Isaac Taylor, M.A., Litt.D., Hon. LL.D., etc. Cr. 8vo, pp. xi.—339. (London : Walter Scott.) Price 3s. 6d.

The author lays no claim to originality, but gives in a condensed, yet clear form the opinions of the chief authorities on the subject. The book contains an accurate statement of facts bearing on the subject, gleaned from various sources, and also the arguments and conclusions based on these facts. It well deserves a place among the "Contemporary Science Series."

Rambles and Reveries of a Naturalist. By the Rev. W. Spiers, M.A., F.G.S., F.R.M.S. Cr. 8vo., pp. 256. (London : Charles H. Kelly.)

This book will be read with pleasure and profit by all students of nature. It is not written in defence or refutation of any theory, but, true to its title, it simply gives a well-written and deeply interesting account of the rambles of one who is a good observer, and who possesses much knowledge of the marvels and processes of Nature. We feel sure the book will awaken, as well as increase, a love of that science which its students invariably find most healthful and absorbing. Its various chapters treat, amongst other subjects, of Seaweeds, Rambles in Cornwall, the Channel Tunnel, Marvels of the Pond, Tiny Rock-builders, Star gazing, An Evening at the Microscope, etc. There are 63 excellent illustrations.

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STUDIES IN EVOLUTION AND BIOLOGY. By Alice Bodington. Cr. 8vo, pp. xii.—222. (London: Elliot Stock. 1890.)

Few works have been read by us with greater pleasure and interest than Sketches in Evolution and Biology, by Mrs. Alice Bodington. Whether one agrees or not with the author's views of Evolution, it is not easy to lay down a book so clearly and attractively written; she has grouped together in the most effective way for her purpose, a vast mass of facts, and has made splendid use of the twenty-four books and authors to which she refers, and a list of which is given in the preface. When a writer like Mrs. Bodington adorns whatever subject she touches, it is difficult to select from her essays any for special commendation. However, we will mention the Second, on Mammalia; the Third, on the Flora of the past; and the Fifth, on Bacilli or Micro-organisms. These seem peculiarly interesting; but the entire book is well worth thoughtful reading.

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GLIMPSES INTO NATURE'S SECRETS, or Strolls on Beach and Down. By Edward Alfred Martin. Cr. 8vo, pp. x.—125. (London: Elliot Stock. 1890.)

This interesting little work is divided into two parts; the first is devoted to an attempt to bring under the observer's notice a few facts relating to those creatures of the sea shore, which are always replete with interest to the seaside sojourner. In the second part the reader is made familiar with the study of the ancient history of our globe, as handed down to us in the form of rock-written stories, giving us glimpses of the various phases through which the earth has passed. We are much pleased with the book.

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DIE NATURLICHEN PFLANZENFAMILIEN. Von A. Englerund K. Prantl. (London: Williams and Norgate. Leipzig: W. Engelman. 1890.)

Nos. 37 to 43 of this famous work are to hand, and treat of the following families:—Clethraceæ, Pirolaceæ, Lennoaceæ, Ericaceæ, Epacridaceæ, and Diapensiaceæ, by O. Drude; Myrsinaceæ and Euphorbiaceæ, by F. Pax; Candolleaceæ, by S. Schönland; Calyceraceæ, by F. Hock; Composit, by O. Hoffmann; Desmidiaceæ, Zygnemaceæ, Mesocarpaceæ, Volvocaceæ, Tetrasporaceæ, Chlorosphæraceæ, Protococcaceæ, Hydrodictyaceæ, Ulvaceæ, Ulothrichaceæ, and Chætophoraceæ, by N. Wille. Every subject in this work is treated in a most thorough manner, the illustrations are numerous and good; in the seven parts before us there are 189 engravings, containing no fewer than 1405 separate illustrations. We cordially recommend the work to our botanical readers.

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POND LIFE, Algæ, and Allied Forms. By T. Spencer Smithson. Crown 8vo, pp. 93. (London: Swan Sonnenschein and Co. 1890.)

This volume of the "Young Collector" series forms a nice companion volume to No. 5, which treated of insects found in the ponds and rivers. The book opens with a Table of Classification of the Algæ; in the introductory chapter, instructions are given for collecting this interesting class of plants. There are also upwards of 30 good illustrations.

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BY CANOE AND DOG TRAIN. By Egerton E. Young. Cr. 8vo, pp. 267. (London: C. H. Kelly. 1890.) Price 3s. 6d.

This book gives a most interesting account of the life and labours of Mr.

and Mrs. Young among the Cree and Salteaux tribes of North American Indians. Their labours appear to have extended over about 20 years, and to have been productive of much good. The Rev. Mark Guy Pearse has written the preface to this book.

YEAR BOOK OF THE SCIENTIFIC AND LEARNED SCCIETIES of Great Britain and Ireland. 8vo., pp. vi.—230. (London: Charles Griffin and Co. 1890.)

The present volume is the seventh annual issue of this most useful publication, and contains lists of papers read during 1889 before societies engaged in fourteen departments of research, with the names of their authors. All scientists should possess a copy.

THE WAY TO PROVE A WILL. By Almaric Rumsey. 12mo, pp. 127. (London: John Hogg. 1890.) Price 1s.

This is by the same author as "Will-making made safe and easy." By studying this book we are assured that executors or next-of-kin may readily obtain probate or letters of administration, without burdening the estate with unnecessary expenses. Full instructions are given When, How, and Where to apply, together with Tables, Forms of Oaths, Bonds, etc., etc.

THE STORY OF THE EARTH AND MAN. By Sir J. W. Dawson, LL.D., F.R.S., F.G.S., etc. Crown 8vo, pp. xii.—411. (London: Hodder and Stoughton. 1890.) Price 7s. 6d.

We are pleased to find that this very readable work has reached a tenth edition. In it the writer treats of the science of the earth as illustrated by geological research, divested as far as possible of merely local colouring, and of the prejudices of specialists.

The fifteen chapters into which the book is divided, treat first of the Genesis of the earth, then of the different Geologic Ages, and finally of Primitive Man.

MODERN IDEAS OF EVOLUTION, as related to Revelation and Science. By Sir J. William Dawson, C.M.G., LL.D., F.R.S., etc., etc. Crown 8vo, pp. 240. (London: The Religious Tract Society. 1890.)

This is another work by the same author. He tells us its object is to examine in a popular manner, and to test by scientific facts and principles, the validity of that multiform and brilliant philosophy of the universe, which has taken so firm a hold of the science and literature of our time.

The writer divides his subject into ten chapters, which treat of The Present Aspects of Evolution, The Origin of Life, The Appearance of species in Geologic time, Monistic, Agnostic, and Theistic Evolution, God in Nature, Man in Nature, etc., etc.

SEVERN TO TYNE, the Story of Six English Rivers. By E. M. Edwards. Crown 8vo, pp. 248. (London: C. H. Kelly. 1890.) Price 2s. 6d.

This is a book written for young people, and describes in very readable language the Thames, Severn, Tyne, Yorkshire Ouse, and the Humber. The four introductory chapters treat of What becomes of a shower, Underground Fairies, Seas and Rivers, etc. It is very nicely illustrated.

ANNE BOWMAN'S NEW COOKERY BOOK. Crown 8vo, pp. 635. (London: Geo. Routledge and Sons.) Price 1s.

This is said to be a complete manual of English and Foreign Cookery, on sound principles of taste and science, comprehending carefully tried receipts for every branch of the art. We find it contains nearly 1,750 receipts and a complete index.

Little Abe, or the Bishop of Berry Brow. By F. Jewell. Crown 8vo, pp. xi.—187. (London: C. H. Kelly. 1890.) Price 1s. 6d.

Abraham Lockwood, a quaint and popular local preacher, is the "Little Abe" whose history is here given. Mr. Lockwood was a native of Huddersfield, and the book is rendered additionally interesting by the conversational parts of the narrative being written in the Yorkshire dialect.

My Black Sheep. By Evelyn E. Green. Crown 8vo, pp. 182. (London: C. H. Kelly 1890.) Price 2s.

An interesting tale, which we cordially recommend to our young friends.

Temperance History. By Dawson Burns, D.D. Vol. II. Part I. 8vo, pp. 188. (London: National Temperance Publication Depôt.)

This interesting work gives a consecutive narrative of the rise, development, and extension of the Temperance Reform. The part before us covers the period between 1862 and 1880.

The Art and Practice of Indoor Photography. By F. W. Mills. (Huddersfield: Alfred Jubb. London: Simpkin, Marshall, and Co. 1890.) 8vo, pp. xiv.—123. Price 7s.

The instructions given in this book are extremely plain. It is divided into two parts; the first treats of the apparatus, exposure, the dark-room, developing solutions, making the negative, green fog, hallation, and frillings. Two chapters also treat of the value of colours, and Orthochromatic Photography. Part II. treats of various Printing Processes. There are three photographic plates showing interiors, but we have certainly seen a better view of the interior of Bath Abbey than the one here given.

Platinum Toning. By Lionel Clark.

Cameras, Lenses, Shutters, etc.

Experimental Photography. By C. J. Leeper, F.C.S.

Art Photography. By H. P. Robinson. (London: Hazell, Watson, and Viney. 1890.)

These are the first four volumes of the Amateur Photographer's Library. They are crown 8vo size, very neatly bound in green cloth, and contain an average of 100 pages each.

No. 1, in addition to toning, gives instructions for the preparation of the sensitised paper. No. 2 is the first volume of a series of competitive papers on Photography, which gained the first, second, and third prizes, and will be found to contain a considerable amount of practical and valuable information and instruction. The title of No. 3 explains the purpose of the volume. No. 4 consists of 12 chapters. and treats of the following amongst other subjects: Nature and Art, the Application of Composition, Terms used in Art, Forms of Composition, the Sky, Figures in Landscape, In Action, Combination Printing, etc. These will form a valuable library at a cheap price.

Fallowfield's Photographic Annual. This is a large 8vo catalogue of some 430 pages of photographic materials and apparatus, sold by J. Fallowfield, of Charing Cross Road, London. In addition to the catalogue, complete working formulæ for most of the processes are given. The photographer will find this a useful book.

Traite Pratique Photogravure sur Verre. Par A. M. Villon. Crown 8vo, pp. vi.—32. (Paris: Gauthier Villars et Fils. 1890.)

In this work the author has put within the means of all, whether workman or artisan, amateur or artist, the most simple way of using photography for the decoration of mirrors, church windows, and other artistic glass.

Life in Death, as Manifest in Falling Leaves.

By Rev. F. Ballard, M.A., B.Sc., F.R.M.S., Etc.

Plate XV.

THE falling leaf has been from time immemorial a *thème de luxe* of the poet and sentimentalist. Nor can any, save the colour-blind, be coldly callous to the warm tints of beauty which diffuse themselves in autumn through the vegetable world. Nature's blush, as she puts off her robe of living green to doff her winter garb of poverty, merits our most respectful regard.

Yet the notion that autumn is a time of general decay adds but another to the myriad popular fallacies which it is the function of science to dispel. The fall of the leaf, in fact, despite all the tender moods of poetry and the sighs of the love-lorn, is a token and a result, not of death, but of life. The vital processes involved in the forming of the reddish-brown heaps that rustle and crackle around our feet in an October walk, are as definite and wonderful as they are oft entirely overlooked.

To appreciate these we must learn, as science would ever teach us, to look beneath the surface of mere seeming into the heart of nature's realities. Nor does the beauty of the distant landscape suffer any loss at all from our knowledge of the biological history of leaves and flowers close at hand, or of the grass beneath our feet.

The case before us is one especially concerned with that constant struggle for existence, which our eyes are now opened to see going on wherever life is known. The acknowledged uncertainty of our climate detracts nothing from the general certainty of a definite and abiding difference in temperature between summer and winter. We who live in these "temperate" zones, must accustom ourselves to variations and extremes of season-changes which are wholly unknown in tropical regions. And the vegetable world, no less than the animal, has to learn to face these realities. In fact, plants are said to be even more sensitive to variations in temperature than animals.

Thus, from the rustle of the drying leaves, even before they fall, we hear once more the old story of that adaptation to environment, which characterises all life. Trees, as well as men, must find how to endure through winter if they would luxuriate in summer. Spring's apparently new created vigour, and the seeming decay of autumn are, after all, only the natural steps whereby the transition from one adapted condition to another is gently broken.

Plants are, moreover, in a somewhat worse case than animals, seeing that they have no power to transport themselves from one region to another. The genus, or even the species, may gradually migrate to pastures fresh through the kindly free-porterage of seed by wind or insects. But the individual plant or tree must live or die where it stands rooted in the soil. Without a root there is for it no life, but with the root no travelling.

In these days we know happily how easy animal locomotion permits the debilitated city merchant and the weary brain-worker to seek bracing air by the seaside. The consumptive patient can prolong life by removing his bodily apparatus to Grand Canary or Madeira. Not so the plant. It must remain *in situ*. The tonic, or preservative, of change of clime, cannot enter into its pharmacopæia. Whatever comes or goes, it must face all in patience. It must adapt itself to environment, or cease to be.

This brief biological preamble is really necessary to our present study. For it conveys the essential principle of that whole phenomenon before us which most people so easily ascribe to death and gravitation. As a matter of fact, the latter has next to nothing, and the former quite nothing, to do with it. The falling is a mere trifle in the matter. And the process is entirely a vital one; the decay of the separated leaf being but a following accident, which may here be left out of account. Before the separation it is so genuine a case of *euthanasia* as to refuse to be worthily called death. There are, at least, three distinct vital processes concerned in falling leaves, and these all based upon a definite principle which is nowhere in nature more wonderfully and instructively exhibited.

The principle is one of economy. The processes are those which effect (1) the avoidance of loss of valuable material; (2) the actual removal of an organ no longer profitable to the tree; (3) the protection of the tree from injury at the points of removal.

We will glance briefly at these, concerning ourselves now only, of course, with trees which we know as "deciduous." Everyone understands to-day how entirely the vegetable world is dependent upon Chlorophyll. Thanks to the modern diffusion of scientific knowledge, there are but few who have no idea of this fact. Not everyone, however, apprehends in this connection the supreme importance of leaves to the tree that bears them. That they are the true functional representatives of both lungs and stomach, is a fact only dimly grasped by very many of those who are "fond of flowers." Nor would they probably be disposed at first to admit that the leaf is a more highly organised structure than the flower, and of much more value to the parent organism. Yet so it is, though here we must assume rather than stay to prove.

Now, we are almost all aware that a certain temperature must be maintained in the animal stomach, if digestion is to take place happily. The exception is apparently found in the case of those who flood themselves inside with *cold* water by way of commencing dinner. A better prescription for the sure acquisition of dyspepsia could hardly be invented. And the harm is not, as is sometimes thought, in the "dilution of the gastric juice," but in the reduction of the temperature. Thus Dr. Beaumont observed that the introduction of a single gill of water at 50° F. into the stomach lowered its temperature upwards of 30°, and its natural heat was not restored for more than half an hour. And when a bottle containing food and gastric juice—easily digested at 100° F.—was exposed to cold air, scarcely any digestion at all took place. So much for the practice—as sensible as many other items of fashion—of taking ice and iced cold water with a meal.

To return to Chlorophyll. It is found that its important functions can only be discharged at a temperature varying between 6°—40° C., or 40°—90° F. This manifestly requires direct sunlight, and an absence of cold winds, frost, etc. Now, whatever doubts we may have concerning to-morrow's weather, we know well that between any autumn and the following spring we shall have more or less of the latter, with a great deal less of the former. Hence, very little, if any, assimilation could be carried on in the leaves by the Chlorophyll, even if they hung on all the winter through.

The tree, therefore, is very much in the position of some of our modern houses of business, which, during the season, put forth branches at the various watering places, and do a thriving trade. But, when winter drives custom away, they find it pay best to withdraw their "staff" and stock, and close until the next season.

It is no less plain that if all leaves remained *in situ* through the winter, the balance of profit would turn against the parent tree instead of for it. Those which, during summer's sunshine, are the great source whence the tree draws its supplies and grows thereby, would have themselves to be supplied whilst winter's cold prevailed. The cost of such nourishment and repair through the cold dark months would have to be subtracted from the proceeds of summer work. The tree would be by this so much the loser that plain principles of economy, working in nature according to the law of each organism's being, not by caprice as in human nature, demand their removal.

(2) But even this called-for removal is done economically. As the business firm which closes its season-shops takes good care first to remove all valuables, so before the leaves are dropped off their respective branches, they are previously drained of their precious contents by processes which collect, transform, and transport them into persistent reserves in the parent organism. Thus, when winter once more melts into spring, and the vital mysteries of spring-energy begin to express themselves in renewed growth, there are materials at hand to work upon, so that forces from within and from below may combine to produce the new buds whence are to come the twigs, branches, and leaves, for another season's ingathering.

To describe in detail the draining processes referred to, would require no little space. It must suffice here to note that it varies in different trees. In the Vine, the form of the Chlorophyll corpuscles is first destroyed; then the colour goes. In the Elder and Poplar the form and colour of these minute bodies melt away together, after the earlier disappearance of the starch. In the Horse-chestnut all seem to go about the same time. The main point to be observed is that there is a definite emptying by means of colliquative changes in the Chlorophyll bodies. And it is to these changes, with their results, that the well-known hues and tints of autumn are due. Thus (i.) in place of the real green and definite form of the Chlorophyll corpuscle there are found in autumn leaves, before they fall, numbers of yellow oil drops, with still larger quantities of very small yellow granules. Their colour and substance are quite distinct from the Etiolin which precedes the appearance of Chlorophyll. They are, moreover, often embedded in red sap, whence arises the beautiful colouring which some leaves exhibit. (ii.) The means by which this economic work is done will be easily apprehended by all who bear in mind what is known as the Fibro-Vascular System. This is far too complicated to admit of detailed description here. Any good book upon Botany, moreover, (*e.g.*, Prantl and Vines) will supply the requisite information. Perhaps the best possible illustration of this system is found in those specimens of the "veins" of leaves, which are often obtained by maceration of the softer parts. These so-called veins, when examined microscopically, exhibit a series of tubes and vessels, the function of which is exceedingly difficult to define in detail, but which amply suffice to afford channels whereby food materials may be transported. It is not needful, therefore, to step aside here and decide the mixed puzzles of Histology and Biology. That (iii.) the emptying process referred to does take place, can be shown to conviction in several ways. First, by micro-chemical testing, which shows that in the just fallen leaf there is scarcely a trace of starch, whereas the vigorous leaf abounds with it. Or, again, it may be demonstrated by testing carefully the chemical constituents of the ash of a leaf in full vigour, as compared with that of one naturally fallen. The presence in the former, and absence in the latter, of potash and phosphates is manifest and sufficient.

(3) The drained leaf-skeletons being then, obviously, of no service to the parent organism during the following six months, it is highly desirable that such should be removed. And in con-

sidering how this comes to pass, we are brought face to face with another of those marvels of anticipation in nature which so deservingly astound us, and land us ultimately in life-mysteries which laugh at all our theories of Biology. What, for instance, do we know of the processes whereby, in the dark and under water, the eyes of Libellula are fashioned, with their four-and-twenty thousand facets? We can only say, with Topsy, that we suppose they grow. And it is a no less remarkable work of nature which underlies by anticipation the autumnal leaf-fall.

Long before the leaf shows any signs of dissolution there are internal indications of a coming change. These consist in the development of two new cortical features at the base of the petiole, viz., Periderm, and the Absciss layer. The latter is a layer of special cells—smaller, more rounded, and more loosely coherent than the ordinary cortical parenchyma—which is formed immediately beneath the base of the leaf-stalk. This is not always equally easy to make out distinctly, yet it may be plainly observed in the following:—*Æsculus Hippocastanum* (Horse Chestnut), *Robinia Pseudacacia* (bastard Acacia), *Populus dilatata*. If access to *Gymnocladus canadensis* (Kentucky Coffee-tree) be possible, it is a specially suitable subject for illustration, and may be experimented on. Thus, if strong leaves are placed in the dark and damp, an Absciss layer is formed at once under the base of the leaflet-stalks, so that in about two days the leaflets drop off on the slightest touch.—*(cf. Strasburger, Eng. tr. Ed. by Hillhouse.)*

Almost equally good subjects for investigation are *Ailanthus glandulosa*, *Fraxinus excelsior*, and *Juglans regia*. For ordinary students, the Horse Chestnut is best, both because of its easy accessibility and plainness of demonstration. The accompanying sketch is taken from a petiole insertion last autumn, and is fairly typical. (Pl. XV., Fig. 1.)

When the Absciss layer is fully developed, the leaf drops off with a very small amount of mechanical disturbance, thus especially through the force of the wind.

Sachs also interestingly states how temperature effects a similar result. The cells of the Absciss layer being loose and rounded, allow of the presence of more water than usual in their interstices. Thus with the first frosty nights of October, a thin plate of ice is formed, as a plane of separation from the parent branch, underneath the base of petiole. The well-known expansive power of ice acts here as elsewhere. Consequently the leaf and its stalk are gently all but severed from the tree. And when the sun arises, there is in its rays sufficient heat to melt the ice film, whence, in the morning, leaves drop off in great numbers.

(4) But the anticipative power of nature is still more manifest when we consider the means adopted for prevention of injury at the points left bare by the removed petiole. Ordinarily, of course, the fibro-vascular threads which ramify through the leaf-blade are collected together into a string or bundle, passing down through the leaf-stalk and joining others in the parent branch or tree. But, whilst the Absciss layer immediately precedes the fall of the leaf-stalk, there is much earlier a remarkable formation (on the inner side of where it afterwards appears) of what is known as Periderm.

To make this intelligible to non-technical readers, it must be pointed out, as tersely as possible, that plants require a "skin" as much as animals. They can no more afford to have bleeding spots without a protecting cuticle, than we. Hence, they are provided with an epidermis, which in all trees and large plants involves more or less of cork. Generally, the epidermis serves three functions—(1) prevention of excessive evaporation; (2) protection from injury; (3) strengthening. Here we are concerned with (1) and (2). It must be remembered, that what is properly termed cork, really involves several distinct layers of cells, histologically considered. The most important is a layer of actively dividing cells, known as Phellogen or Cork Cambium, from which are formed externally Cork proper or Phellem, and internally Phelloderm. The whole of these is included in the name Periderm (see Pl. XV., Fig. 2).

Now, it is of great importance that a corky shield should protectingly cover up for the winter the spots which are left naked by leaf-fall. But this can only be done from within. Nothing can grow out from the external cork to form a covering. As a matter of fact, the Periderm is formed long before leaf-fall, even whilst the Fibro-vascular bundles are in full discharge of their functions. Hence, they pass right through this growing plane of Periderm, and their broken-off ends at first project when the petiole is actually removed. And it is to these the peculiar marks are due, which are seen in every "leaf-scar."

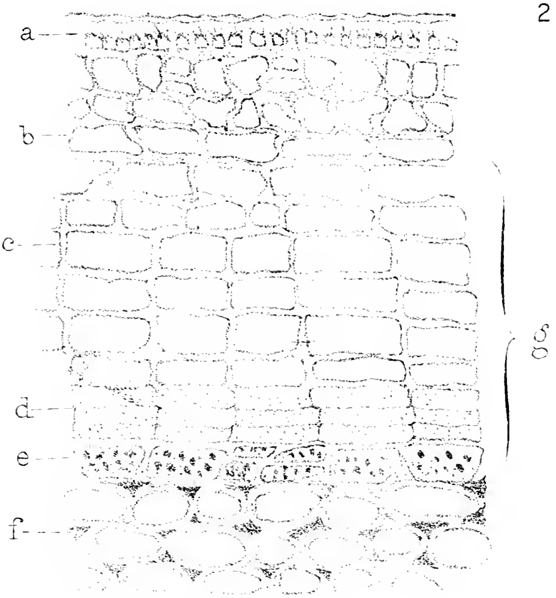
When the leaf-stalk drops off, carrying the Absciss layer with it, there is left behind at first, apparently, some greenish parenchyma cells on the outside. But the foregoing section shows that under this veil of parenchyma there is already prepared a layer of periderm, with its plane extending beneath the whole, except through the Fibro-vasal bundles. But now it begins to develop through these also, that is, right across the roundish area left bare. Consequently the outer cells just mentioned dry up, and ultimately a completely closed layer of cork is formed over the recently exposed tender spot. This increases somewhat in thickness until the branch is effectually protected against the coming storm and cold of winter. Thus the tree remains adapted to its environment, until once more spring draws on, and the daily increasing amounts of heat and light indicate that it is safe and profitable to put forth again buds and leaves. Then recommences that fixation of carbon, with evolution of oxygen, whereby the tree itself is nourished and the healthful balance between the vegetable and animal world is so wondrously maintained. It seems to me impossible to attribute the marvellous inter-working of all these processes, reasonably, to mere fortuity.

EXPLANATION OF PLATE XV.

Fig. 1.—Medial vertical section through insertion of Petiole in Autumn before fall of leaf. *Æsculus Hippocastanum*—showing—*a*, *g*, epidermis; *b*, *i*, fibro-vascular bundles; *c*, cortical parenchyma; *d*, absciss layer; *e*, periderm forming; *f*, parenchyma; *h*, medullary rays.

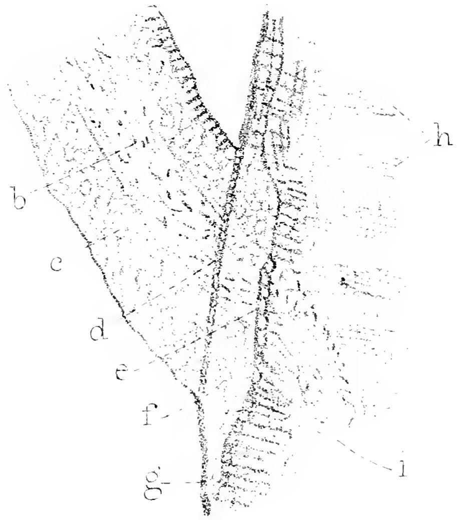
,, 2.—Transverse section of *Ribes nigrum*, showing Cork formation of first year:—*a*, epidermis; *b*, cortical parenchyma; *c*, phellem (cork from cambium); *d*, phellogen (cork cambium); *e*, phelloderm; *f*, phloem (bast); *g*, periderm.

2



Cork formation first year.

1



Section through Petiole before fall of leaf.

On a Curious Want of Ingenuity in the Harvesting Ants of France.

By G. H. Bryan, B.A.

THE custom which prevails among certain kinds of ants mostly inhabiting warm climates, of collecting seeds and of storing them in subterranean granaries to be used for food at a future time, presents many points of interest. It seems to have been well known to the ancients, as is abundantly proved by their writings. Not only is the ant frequently set up as an example of "providence," but its custom of storing *corn* is explicitly mentioned in many old writings, as, for example, where Virgil compares the march of the Trojan army to ants plundering grain. This simile may doubtless seem far-fetched to many readers, for there is not much resemblance between a train of ants and an English regiment. But in Italy, where I saw a troop of the rifles or "Bersagliere" marching through the town at five miles an hour with their knapsacks on their backs, I at once thought of the resemblance to ants rushing along, and only afterwards found that I had been forestalled in this idea.

These statements were nevertheless discredited for some time by observers living in temperate climates that do not allow of seeds being prepared underground by the ants, but later observations proved that Virgil and company were right after all.

While in tropical countries the ravages committed by the harvesting ants in plundering corn became a serious nuisance, several European species of Formicidæ store seeds in their nests, to a greater or lesser extent, and on the shores of the Gulf of Genoa no less than four "harvesters" were observed by the late Mr. Moggridge. It was after reading his interesting account of their habits during a visit to Mentone in 1878 that my attention very naturally turned to these insects, and within a short distance of our villa I was able to watch them storing the achenes of the Oriental Plane tree. My astonishment may readily be imagined when I found that in getting the little fruits into their nests, these ants exhibited an amount of blundering and apparent stupidity, contrasting strangely with their usual ingenuity.

On walking along an avenue of plane trees that extends for some distance along the Valdu Carei at Mentone, at the time of year when the large balls on the trees are breaking up and scattering the living little achenes over the road, some of these appeared, at a hasty glance, to be walking about, but on closer observation it was immediately seen that they were being transported by ants *(Alta barbara)*. Tracing them to the nest I found numbers of others lying around the entrance preparatory to being taken inside, while two or three ants were expending an immense amount of time and trouble in endeavouring to drag one of them down in the only way which could present any difficulty, and that difficulty a very considerable one.

Although the form of these achenes is doubtless well-known to most of my readers, it may be as well to describe them before going further. They are conical in shape and attached to the receptacle by their narrow end, this form being due to the manner in which they are closely packed together into round balls. A pappus of soft hairs, slightly shorter than the achene, springs from the narrow end or base, and these, before the balls of fruit break up, are folded around the achene, so that after the latter is set free, the pappus hairs still remain more or less reflected over the achene, thus resembling in position the ribs of a half-expanded umbrella. The likeness to an umbrella is further increased by the remains of the pointed style at the broad or upper end, which being frequently curved fairly represents the handle. On the broad part are arranged a number of branched or irregularly stellate hairs. These, together with the hairs of the pappus, form pretty polariscope objects if mounted in balsam, but what their use is, it is difficult to imagine, unless they help to hold the various achenes together in some manner before the clusters break up.

Such being the structure of the achenes, it would obviously be a very simple matter for the ants to take them underground, if they were pushed into their nests with the narrow end downwards, as then the hairs of the pappus would merely close round the achene and offer no obstacle. But this is just what the ants do not do. Instead of that, they try to pull them in with the broad end (corresponding to the umbrella handle) foremost, with the result that the hairs, of course, stick out against the sides of the entrance to the nest and prevent the seed from going in. The ants then pull and pull at the end, and after many long struggles succeed by force in making the hairs give way and the seed go in; but this takes several ants a long time, and meanwhile other ants are bringing fresh supplies, which have to wait outside till their turn comes to be treated in the same way.

By way of experiment I took one of the seeds out and placed it in the opening, with the pointed end downwards. The ants at once pushed it out again, and, after turning it round, began pulling it in "handle" end foremost, as usual. I repeated the experiment, pushing the achene in a little further, but the ants still thought they knew better than I how the thing ought to be done, for they again took it out, inverted it, and, of course, had the same trouble as before. At last I pushed a third achene right down into the aperture, this time so far that the hairs standing up would make it difficult to get it out again. This time, however, the ants seemed to think it not worth while to turn the achene, so they pulled it in as it was, with the pappus hairs pointing upwards, and, of course, got it in much quicker than the others. But the ants did not profit by this experience; on the contrary, they again began to pull some more achenes in with the broad end foremost and the hairs pointing downwards.

What is still more astonishing is that having got the achenes inside, the ants *then* take off the hairs and throw them out again into a rubbish heap or "midden" near the entrance of the nest. In this way they have the double trouble of taking the achenes in, encumbered by the hairs, and of taking the hairs back again. Why do not they nip off the hairs before taking them inside? This would be by far the easiest course to pursue, and would save the trouble caused by the hairs getting in the way.

I think the following may be an explanation of why the ants do not do this. The avenues of plane trees at Mentone are comparatively modern, while colonies of *Alta barbara* have been wont to store various seeds in their nests for countless ages, long before this coast was overrun by the Saracens, and inhabited by barbarous races. If we also remember the comparatively small number of ants' nests that are near the plane trees, it is not to be wondered at that they should not have learnt how to obviate any special difficulties that the storage of these achenes may present, apart from those presented by other seeds. Now, in the case of most seeds, it is far more convenient for the ants to collect them as rapidly as possible, and then, having done this, to remove their husks as time permits. When, for example, the nuts of the rosemary (*Rosemarinus officinalis*) are being harvested they are found contained in the fallen calyx, and to strip the latter off at the entrance of the nest would take a considerable time and cause as much delay as their *not* doing this causes with the plane fruits.

It is a well-proved fact that while all insects, and most especially the social Hymenoptera, possess a large degree of hereditary instinct, which enables them to perform the ordinary duties of their life with apparently extraordinary ingenuity; they nevertheless are very deficient in that reasoning power which would enable them to adapt themselves to unusual circumstances. The present observations would tend to confirm this theory, and show us that even the experience of a considerable number of years has not been sufficient to teach these interesting little creatures to modify their methods of harvesting in order to meet a special difficulty.

FROG-FARMING.—We learn from the *Scientific American* that a frog-farming industry, promising profitable results, has sprung up at Menasha, Wis., U.S.A. It is already stocked with 2,000 females, which are capable of producing from 600 to 1,000 eggs at a time. The owner of the farm gives some interesting facts relative to the frogs' habits which are not generally known. He says :—" In ninety-one days the eggs hatch. The thirty-ninth day the little animais begin to have motion. In a few days they assume the tadpole form. When ninety-two days old, two small feet are seen beginning to sprout near the tail, and the head appears to be separate from the body. In five days after this they refuse vegetable food. Soon thereafter the animal assumes a perfect form. Next spring 25,000, at 20 cents. per dozen, will be my reward. Figure to yourself, says the enthusiastic frog farmer, and see if there is any money in batrachia."

Some Thoughts on Light.

By F. W. Sutcliffe, F.R.M.S.

WHAT is light? This question has often been asked, and a variety of theories propagated by way of answer.

For a long time it was generally supposed that light was an emanation of particles from some luminous body or bodies, and that just as the minute particles of some gaseous body are carried along until they reach the organ of smell, producing in that organ the peculiar sensation of smell, so the philosophers of old imagined that minute particles emanated from a variety of special bodies, and were carried along until they eventually came into contact with the eye, thereby producing the sensation and idea of light.

But this is an exploded theory, and the philosophers of to-day are inclined to the opinion, that the phenomenon of light is produced solely and simply by undulations in, or vibrations of an elastic air. Every luminous body is regarded as the seat of a motion which is in some peculiar way transmitted to our optic nerve, arousing in that nerve a sensation of brightness.

Dr. Lommel puts the matter very clearly in his work on Optics, when he says that there are only two modes by which movement may be propagated from one point to another, the first of which is the immediate transference of motion, in which the body itself, or parts of the body, traverse the space between the two points; the second mode of transference taking place mediately through some elastic intervening medium, and in which medium the original motion excites a vibratory movement which is propagated from particle to particle, to a great distance, without any particle of the original body moving from its first position.

Now, it is undoubtedly admitted, that it is by this latter undulatory movement that light is spread; and we find that there are certain peculiarities connected with the action of both light and sound, which go to prove the truth of this assertion.

Following out certain experiments as directed by Dr. Lommel, we arrive at the curious and startling result that light added to light under proper condition produces darkness. Now, on the supposition of the first or emission theory, the fact that light added to light produces darkness, is wholly inexplicable, whilst if we accept the latter or undulatory theory, the matter becomes easy to explain. Therefore, setting aside the view that light is itself material, it becomes necessary for us to consider the nature of the medium by which such a phenomenon is transmitted to us.

We are all aware that our atmosphere forms but a comparatively thin envelope around the surface of this globe, and when we consider that the light of all heavenly bodies is transmitted to us by undulation, we are forced to admit that it must be through some other medium than the atmosphere. Hence, it is inferred that the whole universe is filled with an elastic rarified substance which opposes no appreciative resistance, and this material has been termed ether.

According to Prof. Huyghens, light consists of very minute vibrating movements of this elastic ether, such movements being propagated with great rapidity—but not instantaneously—in straight lines, which proceed like the radii of a sphere from a central point common to all. Originally, the idea was accepted that light was a direct propagation along a single straight line, thus allowing of a possible isolated ray, but the existence of an isolated ray is now held to be inconceivable.

It may be interesting to consider some of the elementary effects of light, such as its source, its direction of transit, and the aberrations which it undergoes. We will then proceed to investigate the first branch of optical science, viz., Perspective, and afterwards make some reference to Caloptrics. Light, as we have previously stated, travels in straight lines, radiating in all possible directions from every luminous point.

In the science of light we find that there arises a twofold consideration: first, we must investigate the laws relating to light itself, and then secondly, we require to examine the phenomenon of vision. As to the source of light, we must point out that it seems to be very closely associated with heat, for every form of matter, when sufficiently heated, possesses the power to emit rays of light.

It is probable, therefore, that self-luminous worlds are in a condition of incandescence. Artificial sources of light are dependent for the production of light-rays, upon this incandescent condition. In artificial light we have those bodies which produce flame, and those which have no appearance of flame. Bodies that do not produce light can only be seen by the rays they reflect from some other illuminant. Light may proceed from a self-luminous body or from an illuminated object, but its rays must penetrate the eye before any sensation is produced.

One of the most curious phenomena connected with light is what is called aberration, in virtue of which all heavenly bodies appear a little out of their true place. The difference in the densities of the atmosphere surrounding our globe and the ether pervading all space, have a tendency to refract the light-rays proceeding to the earth, thus causing us to imagine a body to be where it is not. The motion of light in straight lines is probably the first physical fact the student learns, and it is to the exceptions to this law that every variety of ocular illusion is referable.

By studying the rectilinear motion of light, we learn that what is called the pencil of light, which emanates from any given point, diminishes in amount of illumination in proportion to the square of the distance from the source of illumination. Of course the above is only true so far as free space is concerned, and when we consider that a portion of light is absorbed in passing through air, we understand at once that the above remarks do not always apply.

With an elementary knowledge of this subject we very soon find out the fact, that when the action of light is propagated through any medium, and which eventually arrives at another medium of different density, its force is divided and a portion only enters the new medium, whilst the remainder rebounds or reflects backwards. When this rebounding or reflected portion is considerable in amount, the surface or point of reflection appears white, but when all the rays of light are absorbed or allowed to pass through the medium the object appears black.

We learn from a study of this law of reflection, that opacity and transparency are not opposite properties, but rather different degrees of one and the same law, for just as radiant heat of a given intensity penetrates farther through some media than others before becoming entirely absorbed, so with light. Solar rays can penetrate through hundreds of miles of air, but cannot penetrate more than the fraction of an inch into opaque materials. Strictly speaking, it may be said that no substance is either perfectly transparent or perfectly opaque, but practically speaking, some substances are impervious to light-rays. That branch of investigation which is concerned with the refraction of light and similar phenomena, is called Dioptrics.

The application of the laws of refraction accounts for the numerous deceptive atmospheric effects included in the term mirage, and the investigation of Dioptrics has led to a complete understanding of the mechanism of the eye; the result of which has been the perfection of both the microscope and the telescope. Refraction is a common property of light, but is not equal in different kinds of light. Independently of their difference in the degree of brightness, they differ in the quality of refrangibility and absorption, such difference when distinguished by the eye constituting colour. Differences of colour undistinguished by the eye constitute polarisation. All the different qualities of light termed colour exist in solar rays, and it is both interesting and pleasing to separate the varied rays by means of spectrum analysis.

If we study the action of light as exhibited in Photography, we shall enjoy hours of amusement and instruction watching the action of such light on a variety of chemical substances. This investigation would well repay any earnest student, and much might be said on this subject, but for the present we must let it pass. We will just say, in conclusion, that the fact that Capt. Abney has proved the possibility of photographing colour,* ought to be sufficient inducement to encourage unremitting attention to this important branch of physical research.

A picturesque Lake-dwelling has just been discovered under a peat bog near Milan, which differs in many respects from those previously discovered in Switzerland and Upper Italy. The posts are still standing upright, and the planks have been made by roughly splitting trees without the use of any kind of saw.

* It has not, however, been possible as yet to fix the colours.—*Ed.*

Cysticercooids Parasitic in Cypris cinerea.

By T. B. Rosseter, F.R.M.S., Canterbury.

Plates XVI., XVII.

THE present century has been productive of many able workers in the field of Helminthology, both English and Continental, but our countryman, Dr. Cobbold, and Leuckart of Germany, stand out as shining lights, a statement sufficiently warranted by a glance at Spencer Cobbold's numerous works on human and animal parasites, of the " Parasites that exist in Man and Animals." Yet, if we turn our attention to one division, viz., " The Cystoidea," we shall see that but few of this particular class of parasites have been studied ; for Leuckart says, as yet but few forms are known, not more than a dozen. Leuckart enumerates the following :—

Cysticercus	Tenetrionis	becomes	Tænia Musavagina
,,	Arionis	,,	Tænia (probably) of the Red Shark
,,	from, Lymnæus pereger	becomes	T. microsoma
,,	(?) not known	,,	T. gracilis (Perch)
,,	lumbriculi	,,	T. crassivostis (?)
,,	glomeridis	,,	T. pistillium (Shrew) *
,,	gyporhynchus	,,	T. macropeos
,,	elliptica	,,	T. cucumerina (dog)
,,	(?) not known	,,	T. torulosa (?) Cyclops

Echinococcus, from body cavity of Earthworm.

Cysticercus	(?) not known,	becomes	Tænia nana †
,,	(?) ,,	,,	T. flavo punctata †
,,	(?)	,,	T. Madagas-cariensis †

The above is an illustration of the paucity of our knowledge of these minute, yet somewhat important creatures. This is explained not by the want of interest on the part of helminthologists in general, but by the difficulties that beset the path of the investigator. First, in consequence of their habitat being of an uncertain

* I have found T. pistillium in company with T. tiara in intestine of the Mole (Talpa Europæa).

† These three are Human tape-worms.

nature, so that their discovery is frequently more the result of accident than design; second, owing to the minuteness of the creatures in question, and in consequence of their not forming cysts, or true bladders, like their congeners, the Cestodes, they are frequently overlooked, and their discovery is somewhat of rare occurrence.

At intervals during the past few years, I have been engaged in exploring the ponds and ditches in my neighbourhood, Canterbury, for the Cyprides, with a view of determining the different species that exist in this part of Kent; to discover, if possible, their habitat, and hoping to find undiscovered males, as well as to become acquainted with certain Infusorians, which serve as hosts to these minute Crustaceans.

To discover the males, and to become acquainted with their structure, it is necessary to crush the shell of the crustacean and tease out its viscera. Under such circumstances, the reader may be sure that a great number of different species have necessarily passed through my hands, or rather under, the dissecting microscope, for, as I have said in a former paper on this subject,* it is next to impossible to determine male from female without doing so.

Among the many specimens of *Cypris minuta* examined, there was one which harboured a peculiar heart-shaped parasite. This was mounted in glycerine for comparison in case others should be found, but it proved a solitary example. About the same time, I gathered from another pond, Reed-pond, some *C. viviens*, females, and two of them yielded the same kind of parasite in contour, as was previously found in *C. minuta*. These were similarly mounted.

In the year 1887, I discovered in this district the male *Cypris cinerea*, and in the course of preparation of a paper on the male organs, a great number were examined, yet during the investigation none of the parasites in question were discovered, but some time afterwards, whilst examining some of the same species of Cypris taken from another pond, I was surprised and gratified to find they not only were the host of a similar Cysticercus to that which had been previously found in *C. minuta* and *C. viviens*, but also another and quite dissimilar Cysticercooid. These affected Cyprides were found in a pond destitute of aquatic vegetation,

* Journal of Microscopy, Vol. I., N.S., p. 231.

situated in a grazing meadow. Pl. XVI., Fig. 1, represents *C. cinerea* somewhat crushed, to show these parasites or Cysticercooids *in situ*.

It will be seen that they are situated in the dorsal region more towards the posterior half of the creature, and over the intestine. On opening or crushing the valves of Cypris in water, the Cysticercooids float out in the liquid, but are held in check by a long ribbon-like appendage (see Fig. 2, g.), whose end is attached to the concavity of the shell of its host. It is seldom that these parasites are solitary. Fig. 1 possesses two, which is the usual number, but I have found as many as four inhabiting one Cypris.

On being freed from its host, it has a great resemblance to the head of an Echinococcus, Figs 2 and 3, with the anterior part of the head invaginated, but a closer investigation soon dispels this illusion, for although the circlet of hooks is similarly situated, yet in point of structure they are totally dissimilar.

The circlet of hooks is usually situated at the anterior part of the Cysticercus in the medial line.

The cuticle of the Cysticercus is striated or streaked, and at various points in the striation it is fenestrated. Its structure is harsh and firm, and resists the influence of boiling nitric-acid. This cyst or capsule has nothing in common with the Cysticercooid which it contains, beyond its protecting influence to prolong the vitality of the embryonic head, until with its host it falls a prey to some warm-blooded creature, in whose viscera it becomes a perfect *Tænia* scolex, but failing this it perishes with its host.

The ribbon-like caudal appendage (Figs. 2 and 3) readily takes picro-carmine stain and soon becomes disintegrated under the influence of the nitric-acid test. It enters the cyst at the posterior end, where there is a groove or slight depression. This depression is the foramen or commencement of a short, circular tube, which perforates the wall of the cyst and forms a stalk in the interior, the end of the embryo resting on or being attached to it. The ectoderm of this appendage enters the cyst through the hollow stalk or tube, and then spreads itself out and forms the investing membrane of the embryonic head. This membrane is an integral part of the embryonic head, as at the anterior part of the cyst it too becomes invaginated, the developing head being, as it were, suspended in the cyst within this membrane. The approximate length of this appendage is the twenty-third of an inch. At its point of attachment to the concavity of the shell it is very narrow, but gradually becomes broader as it approaches the groove or foramen of the cyst. Its contents consist of a cellular substance, whose nuclei readily stain under the influence of picro-carmine.

The inner wall of the cyst is lined with a thin, transparent membrane or epithelium. Between this epithelium and the membrane which encloses the embryonic head is a watery secretion. It is very rare to find any movement going on within the cyst. There have been times when I have noticed an oscillation, but it has not been very perceptible. The cuticle at the point of invagination closes up, forming a cone, so that it is difficult to find an orifice if one really exists. I have been unable up to the present time to find any trace of the original six hooks of the embryo, which must have previously existed, on any part of the structure of the cyst or the ribbon-like appendage.

On examining the Cysticercooids when freed from their host, there are but faint outlines of the rudimentary head, suckers, or rostrum, the circlet of hooks being the most prominent part of the whole mass. If the cyst is crushed between a slip and cover-glass, or under the compressor, we cannot force out the contents through the invaginated end, as one would imagine if there was an aperture in that portion of the cyst; but it usually becomes ruptured on one side, and the contents, together with the circlet of hooks, are forced out through the ruptured wall of the cyst. Under such circumstances the emitted contents have a plasma-like appearance, bounded by the membrane, and with but faint outlines to indicate the presence of a tænia head. With a view of perfecting the scolex, I tried some feeding experiments on rats and mice, both tame and wild, but by a *post-mortem* examination I was unable to trace them. Steeping the cysticercus in warm water, as Leuckart recommends in the case of *C. arionis*, was useless, so recourse was had to other means. Steeping them in hydrochloric or acetic acid, either cold or warm, did not give good results, so I tried nitric acid, in the first place cold, steeping them for about ten minutes. The contents became more defined, and on rupturing them whilst in the fluid, the expelled contents became coagulated. I then tried warm nitric acid. It would be wearisome to relate my many attempts and failures, but at last I was enabled to produce the perfect head or scolex, and to watch under my instrument the progress and escape of it through the invaginated portion of the cyst. The following was my *modus operandi:*

The Cypris is placed on a glass plate with a drop of water, then crushed, and the cysticercooids freed from the *débris*, a drop of nitric acid being added. The glass plate is then held over the chimney of a lamp until the small quantity of liquid begins to simmer. It is then removed and allowed to cool for a few seconds, then placed on the stage of the microscope, and examined either with a 2-in. or 1-in. objective. The former is preferable, as it does not dull or become affected by the fumes of the warm acid. Little change will be visible at this the preliminary step, but it enables one after a few trials to judge of the length of time for the next process, which is to add another drop of acid and to again subject it to the simmering process. If then it is removed to the stage of the microscope and examined, it will be seen that a great change has taken place. That which before appeared to be a structureless mass of plasma has now become a solid, dark-brown mass, and at the invaginated end of the cyst papilla-like protuberances have begun to form (Fig. 4, *a*). This is caused by the invaginated portion of the cyst being pushed upwards, owing to the development of the embryonic head. This continues to swell and form a dome, and then the watery secretive fluid, spoken of above, which exists between the space which bounds the inner wall of cyst and the investing membrane of the head is emitted from the centre of the dome and flows out in a steady upward stream. It floats away like a flocculent cloud in the surrounding liquid, and quickly becomes absorbed. I have tried to devise means for arresting it for examination, but have not succeeded.

The escape of this fluid has caused a great change to take place within the cyst. The scolex has become more defined, and with the circlet of hooks has begun to move in an upward direction. Instead of lying in a circle they have become oval, owing to the pressure of the formative tissue, and are now vertical to the polar axis of the cyst (see Fig. 5, *c*), the whole mass pushing up the dome-like portion of the cyst until it forms a bladder of a hyaline consistency (Fig. 6, *b*). This bladder still continues to expand, adhering to the now fast-escaping head. The enveloping membrane of the head has become contracted, and is drawn out to a fine point (see Figs. 5 and 6), ultimately breaking away from its point of attachment (Fig. 4) at the posterior end. This is the rule, but there are exceptions (compare Figs. 5—7). The contracting of this membrane has brought into view some very fine muscular fibres, which, having broken away from the posterior portion of the cyst-wall where they were attached, hang down within the cyst in graceful, wavy threads.

The outer membrane or ribbon-like appendage becomes disintegrated under the influence of the re-agent, and finally becomes absorbed if the process is prolonged. In the meantime the head has been gradually progressing, the circlet of hooks slowly moving upwards, until with a sudden jerk the contents of the cyst, consisting of the head, suckers, rostrum, and hooks, are expelled, together with the rudimentary-formed neck, and the observer has before him on the stage of his microscope a perfect Tænia-scolex (see Fig. 7). A portion of the neck in this instance still remains within the cyst, but there are times when the whole mass is freed from the cyst.

The head is spherical (see Fig. 8), and bears four suckers, a rostrum, and a circlet of hooks. It is about three-hundredths of an inch in diameter. In this instance the rostrum is inverted (Fig. 7). In its natural position it appears as an elevation above the head. The suckers are strong muscular swellings, yet they are not such raised prominences as, for instance, in *C. arionis*. Their width is about the one-thousandth of an inch, and length eight-hundredth of an inch, so that they are more oval than spherical in shape.

The circlet of hooks is situated below the dome of the rostrum in a single circle, consisting of from twenty-two to twenty-four hooks. The anterior root is broad, somewhat spatulate ; the posterior root long and slender. The claw is slender, curved, and terminates with a sharp point (Fig. 10). There is a marked resemblance between this hook and that of *Tænia nana*.* Their

* See Leuckart, "Parasites of Man," p. 658, Fig, 341.

Cysticercoids Parasitic in Cypris

Cysticercoids Parasitic in Cypris.

extreme length is about the twelve-hundredth of an inch. The points of the hooks are, on the evaginated rostrum, turned towards the posterior end of the creature.

From an expression of Leuckart's, I learn that the question of these cysts containing fluid is a controvertible point, and I can only express my regret that I am unable to substantiate my assertion from specimens in my possession, having failed to arrest the emission of the fluid for mounting purposes; but I may quote an authority who, like myself, has watched the emission of this fluid, viz.—Mr. Pugin Thornton, M.R.C.S., of this city. Although I have taken *C. cinerea* and other species of the *Cypridæ* from ponds in this neighbourhood and the surrounding districts, embracing a radius of ten miles, yet none of them have been the host of this Cysticercus, and it is only in this one particular pond that they are parasitic in the Cypris. How the pond has become affected is a point which requires solution; neither can I find any record of the knowledge of their existence as parasites in these minute crustaceans.

EXPLANATION OF PLATES XVI., XVII.

Fig. 1.—*Cypris cinerea*, crushed to show Cysticercooids *in situ*, × 50.
,, 2.—*Cysticercus*, with ribbon-like caudal appendage, × 155.
,, 3.—Same, × 350:—*a*, fenestration; *b*, epithelium of cyst; *c*, fluid cavity; *d*, investing membrane of embryonic head; *e*, rudimentary head; *f*, short, circular tube; *g*, ribbon-like caudal appendage.
,, 4, 5, 6.—Cysticercooids in different stages of progression, under the influence of nitric acid, × 150:—*a*, papillar; *b*, same further developed; *c*, circlet of hooks; *d*, dome of rostrum; *e*, thread-like muscle-fibres; *f*, investing membrane of embryonic head.
,, 7.—Head of developed Cysticercooid, × 350:—*a*, suckers; *b*, rostrum inverted; *c*, circlet of hooks.
,, 8.—Head of same flattened to show the suckers and circlet of hooks, Zeiss, $\frac{1}{6}$-in. D.D.
,, 9.—Rostrum, hooks, and suckers, × 350.
,, 10.—Hook of same, × 1,080.

Some Remarks on the Pucciniæ—Attacking Galium.

By the Rev. J. E. Vize, M.A., F.R.M.S.

THE occurrence of a plant when for many years one has been searching for it gives joy to the discoverer. In the month of July in this year I was fortunate enough to find an *Œcidium* growing on *Galium aparine*, and before putting it under the press for the purpose of drying, I noticed on the lower part of the stems of the *Galium*, some intensely black bullate swollen patches, which were unhesitatingly *Puccinia*. They might fairly be taken to be the teleutospore of the *Œcidium*. At once I took it to be *Puccinia difformis*, a fungus which is very unusual in England—at least, so far as my searchings have gone; so also those of Dr. Cooke, because I well remember at the Woolhope Foray last year, at the Forest of Dean, when *Puccinia acuminata* was found on *Galium saxatile*, he asked if I had ever met with *P. difformis*. My answer was No. He had only found it once, I believe, the locality being Shere, in Surrey.

Thus far we have noticed two *Puccinias* growing on *Galium*, *Puc. difformis* on *Galium aparine*, and *Puc. acuminata* on *Galium saxatile*. But there are two other *Puccinias* also growing on *Galium* according to the Handbook, namely, *Puc. Valantiæ* (Pers.) on *Galium cruciatum* and *Puccinia Galiorum* (Lk.) on various species of *Galium*.

On referring to Prof. Saccardo's Sylloge, Vol. vii., p. 600, he gives no less than thirteen species of *Galium*, two of *Asperula*, and one of *Rubia* as the host plants of *Puc. Galii* (Pers.). As a synonym he gives *Puccinia difformis* (Kunze), about which we shall say a little presently. Let me merely say with regard to *Puc. Galiorum* that this plant has its four forms of spores on the same plant in orthodox succession, and they are easily traced from the œcidial stage to the teleutospore.

At page 685, Prof. Saccardo gives *Puccinia Valantiæ* (Pers.) as growing on five species of *Galium* and two of *Mollugo*, four of the *Galium* having been the habitats of the previously recorded

Puc. Galii, against which there may be, and probably are, no objections to be laid. Both the two species of Saccardo, as inserted in his work, are according to my frequent additions of knowledge occurring continually, one preceded by a *Puccinia*, the other never.

We have now Cooke's Microscopic Fungi, last edition, giving four *Puccinias* on *Galium;* Saccardo's Sylloge gives only two.

We now come to the latest date to see what further records may be found. About *Puc. Galiorum* (Lk.) everything is most satisfactory, so it is about *Puccinia Valantiæ* (Pers.), which cannot be mistaken for the other plant, inasmuch as it has large bullate patches of sori, as contrasted with the sori of *P. Galiorum*, which are sparse and small. Even an ordinary observer would scarcely fail to detect the difference.

With regard to *Puccinia acuminata* (Fckl), said to grow on *Galium saxatile*, Prof. Saccardo gives it as a synonym of *Puc. Valantiæ* (Pers.). I have very critically examined my specimens gathered at the Forest of Dean, Welshpool, and Barmouth, and confess that every example of *G. saxatile* seems to correspond with *Puc. Valantiæ*, not only in the external aspect of the fungus but also in the spore. The spores of my specimens are without coloured peduncles, and only a few are acuminate. I hoped to have gained assistance from the only plant of *G. saxatile* of foreign growth. But on looking over it there is not an atom of any fungus on it. Baron Thumen supplied it, and his earlier work never was too accurate. So far, therefore, as my experience goes, our Italian friend is right. I am open, however, to conviction when an opportunity occurs of seeing *Puc. acuminata* (Fckl.). May the chance be soon!

Let us now consider the so-called *Puccinia difformis* (Fckl). Is it a distinct species or is it not? My own theory is clearly that it is distinct, and not as Prof. Saccardo gives it, namely, a synonym of *Puc. galiorum*. No one looking at *Puc. galiorum*, say, on *Galium cruciatum*, and looking at *Puc. difformis* would take them to be the same. The one is a brownish lump of sori; the other is like pitch or tar. On referring to the Handbook I see the remark made about it, which says it is "Very distinct from either *Puccinia galiorum* or *P. Valantiæ*, the sori are firm and compact, like little spots of pitch." Exactly so. Let us look now to Mr. Plowright's "British Uredineæ and Ustilagineæ," a book which is a credit to its author, and especially so because he is a true Woolhopean:—at page 144, speaking of the biologies of *Puc. Galii*, which includes *Puc. difformis* as a synonym, it says, "The presence of the mycelium in the stems, especially in *G. aparine*, causes swellings and distortions." Yes, indeed, they are considerable. If we examine them they are very considerable. They are black and split up the cuticle into fragments. Unless there be further proof of the identity of *Puc. difformis* with *Puc. Galii*, such as the positive growth of the latter from the spores of the former, I cannot think they are the same plant. Besides, not only is the external aspect of the two so very dissimilar, but the shape of the spores, especially at the summit, is not alike. I fancy a little more critical examination of these two species will cause each to have its own name, and therefore that the one is not a synonym of the other.

THE INFLUENZA BACILLUS.—We learn from the *Daily Telegraph* that Dr. Jolles and Professor Weichselbaum, of Vienna, have succeeded in discovering the Influenza Bacillus, after a series of experiments in the Chemical and Physiological Laboratory of the University. The germ is very similar to the Pneumonia Bacillus, although clearly distinguishable from it.

MOUNTING MEDIUM FOR VEGETABLE STRUCTURES.—Mr. Quinn, of the Manchester Microscopical Society, says that the sodium fluosilicate, sold as a disinfectant under the trade name of "Salufer," is an excellent mounting medium for plant structures, preserving the green colouring matter very perfectly, and causing but little change in the shape of the cells. The latter quality is due to the very slight solubility of the fluosilicate in water.

The Study of Entomology.

By G. Chaloner, F.C.S.

I PROPOSE to furnish the student with a few brief hints respecting the best mode of obtaining information and the collection and preservation of specimens. Though the best method of study is the practical one of catching and breeding one's own insects, a few books are indispensable. Of these there are now so many of a cheap and popular character, that it is quite unnecessary to single any out. We may, however, mention Kirby and Spence's Introduction to Entomology, the Young Collector's Handbooks, and the well-known works of the late Rev. J. G. Wood. Those who can afford it will do well to procure Stephens' Illustrations of British Entomology, in ten or twelve volumes, which are worth seven guineas. Curtis's British Entomology is also a good but expensive work ; it contains nearly eight hundred coloured plates. These latter works, however, are luxuries which the many cannot afford, and there are now to be had, for a very small sum, excellent handbooks on every branch of entomology.

Useful, however, as good books are to the student, the study of insects themselves is much more so. It is very well to read that the stag-beetle has five-jointed tarsi, lamellated antennæ, and so forth, but the mind and memory are far more impressed by an examination of the insect itself, and by jotting down its peculiarities in one's own note book. The student should not imagine that he knows all about any insect, even the most familiar, but should make a point of describing every insect he finds, leaving a blank space at the head of his description for its name to be inserted when ascertained. An illustration will perhaps be advantageous.

April 20, 1861.—A— took a caterpillar from the black currant, in a web of its own construction ; $\frac{3}{4}$ inch long, slightly covered with hairs on the lower part of the sides, with a broad, black stripe down the back ; on each side of this are black dots, alternating with reddish dots. Head black, and the first three segments tinged with reddish brown. Besides six thoracic legs, it has two pairs of pro-legs: one pair on the anal segment, and the other on the last but three. Walks geometrically, bending its body thus: Ω.

May 9.—Found *A. grossulariata* had got a new skin, much brighter than the old one, which lay beside it, fastened by the anal pro-legs. It had been sluggishly reposing on the under side of the box lid for some days, spinning a kind of silken carpet, on which it still continues.

May 11.—In D.'s nursery-garden I took 17 *Abraxas* larvæ—much to the gardener's amusement—from a gooseberry bush (*Ribes grossularia*). Fourteen appeared to be *grossulariata;* the other three varied in the markings, being, one of a deeper black and with the yellow stripes degenerated into occasional dots, and two of a dull black, with very little yellow indeed. In all, the head and anal segment were tinged of a brick red.

May 26.—Found three *A. gross.* changed to pupæ, which are black, banded with orange.

June 22.—Three *A. gross.* emerged from their puparia to-day. Three weeks appears to be the time of their pupal existence. The wings are of a pinkish white, with black and orange spots. Learned its name from Wood.—[*Country Objects, 107, Knight, i. 17.*]

Entries after this manner, with rough drawings, which are very instructive, and references to books, should be made about all insects taken. It is not so much trouble as it at first appears, and is repaid by the knowledge it confers.

Collections in museums should be visited as frequently as opportunity permits. When the student has no entomological friends, and but few books, such collections are of the greatest advantage. Suppose he has captured a moth unknown to him; it is easy to take it to the British Museum, if he live in London, and by comparing it with the specimens there exhibited, to ascertain its genus and species. The officials, too, are obliging, and the student, if he is not too troublesome, can generally get access to their private rooms.

Insects can be collected without going to much expense for apparatus. That which is most useful is described in Coleman's British Butterflies, just referred to. In most large towns there are "naturalists," who sell both apparatus and insects; an hour spent in examining the contents, or even only the window of such a naturalist's shop, will go far to acquaint the student with the nature of the nets, etc., used, and he can, with a little ingenuity, make them for himself. An overcoat with two large pockets, the right containing empty pill-boxes, will be very useful. When an insect is caught, the box containing it can be transferred to the left-hand pocket. A pill-box is a useful trap, too. A growing leaf, with an insect upon it, can be secured between the lid and the box with but little trouble. Flies on a wall can be captured by placing a pill-box over them like an extinguisher: the fly soon gets in the box, and the lid can be quickly placed and secured. An open umbrella drawn along the grass brings to hand many prizes; and a newspaper under a hedge will receive the caterpillars which a stroke with the stick shakes off the bushes.

Perhaps the most unpleasant task of the entomologist is to kill his insects. A few pence will procure a year's supply of *benzine collas*, in which a strip of blotting paper may be dipped, and then placed in a wide-necked bottle, and corked up. His captures may be put into it as obtained, and the vapour soon kills them. Chloroform, bruised laurel leaves, or powdered cyanide of potassium, have the same effect. A pinch in the thorax will kill butterflies and small moths at once; large ones, however, need stabbing between the first pair of legs with a knife-point or a clean quill pen, first dipped in a solution of cyanide of potassium or laurel juice. The coleoptera, orthoptera, and hemiptera, are destroyed by immersion in boiling water, and small moths and flies can be killed by the same means, only they should be first placed in a closed bottle, which is then forced under the hot liquid. The heat of an oven is as effectual, but it requires more time and care to effect the purpose, and it is our duty when killing these creatures to select the most speedy death for them, so as not to prolong their pangs—if pangs they feel, which some doubt—unnecessarily. The vapour of burning sulphur is also very destructive, but it damages colours.

The most expensive part of the entomologist's pursuits is the formation of a cabinet for the preservation of specimens. For particulars on this point we refer our readers to Coleman's little work on Butterflies, before mentioned. But we do not believe that a cabinet is absolutely necessary. Its possession too often leads the student to become a mere collector. The most ardent naturalists have not always the largest collection; and the true man of science, or the humble, sincere student, will learn more from the attentive study of two or three insects, than from the mere possession and occasional inspection of hundreds.

Though not absolutely essential, a microscope is very useful to the entomologist, and an unfailing source of amusement and information. A pocket lens is handy in the field (and in passing we would say to the intending purchaser—buy a "Coddington" rather than a "Stanhope" lens); but for minutely examining the structural peculiarities of an insect the microscope is vastly superior. On a future occasion we may recur to this subject, with special reference to preparing specimens for permanent preservation as microscopic objects.

A Homely Zoophyte-Trough.

By J. Anderson Smith, M.D.

MOST amateur microscopists, as they get on in their work, manufacture apparatus for themselves which they think superior in utility, if not in appearance, to articles sold for similar purposes in the shops. Unfortunately, most of these "dodges" are known only to the inventors themselves. The little contrivance I wish to bring before your notice now has proved so useful in my own case that at the risk of describing something that is familiar to others, I do not hesitate to give some account of it.

The constant trouble I had with the usual glass zoophyte-troughs, either from leakage, too great depth, or too large size, led me to try something else. And first I tried cork rings of various diameters and depths, but the difficulty of cutting evenly and the occasional perforation in the cork allowing air-bubbles to get into the cell, soon caused me to abandon these.

I now use india-rubber rings, which give me perfect satisfaction. I take an ordinary glass slide, find the centre, and then fix on to it, by means of Canada balsam, an india-rubber ring, ⅝-in. diameter, ⅛-in. deep, and ⅛-in. thick. Rings of any required size or depth may be used. Filling the enclosed space with the water and weed to be examined until the surface of the water is slightly convex above the plane of the upper surface of the ring, I then place a cover-glass of the requisite size on the top, and the trough is ready for examination. Capillary cohesion holds the cover-slip perfectly tight, so that the trough may be turned upside down without spilling the contents.

The advantages I claim for this little trough are:—1st, its cheapness; 2nd, the facility and rapidity with which it can be made. Moreover, by choosing various sized rings, troughs of any depth and size can be made, and such a trough may be readily used at the pond-side for rapid examination of small portions of the material collected. Lastly, it is less cumbrous than the glass trough and more useful in my experience. The rings I have chiefly used are such as one gets from certain mineral-water bottles; the dimensions given are those of a ring labelled "Matlock Mineral Water Co."

Beetles.

THE long imprisonment of beetles within furniture is treated of in the last report issued by the New York State Museum of Natural History. It is suggested that when such cases occur, the conditions may bring about a legarthic state in which respiration and accompanying phenomena are almost entirely suspended through the complete exclusion of air by the rubbing, oiling, and varnishing, or other polishing the furniture has undergone. This instance of the imprisonment of a beetle is cited, says *The Illustrated American*:—In 1786, a son of Gen. Israel Putman, residing at Williamstown, Mass., had a table made from one of his apple trees. Many years afterwards, the gnawing of an insect was heard in the leaves of the table, which noise continued for a year or two, when a large, long-horned beetle made its exit therefrom. Subsequently the same noise was heard again, and a second insect, and afterwards a third, all of the same kind, issued from this table-leaf; the first one coming out twenty, and the last one twenty-eight years after the tree was cut down.

Dips into my Aquarium.

By the Rev. William Spiers, M.A., F.G.S., F.R.M.S.

Part IV.

Many an amateur microscopist dates, as I do myself, his passion for the study of Infusoria from the perusal of Gosse's delightful *Evenings at the Microscope.* A considerable number of those who will read these lines will remember the glowing description of *Vorticella*, which Mr. Gosse gives in the last chapter of this book; the best wine, as I think, coming at the end of the feast. Mr. Gosse illustrates and writes about *Vorticella microstoma.* I want to say something about *V. nebulifera.* They are very similar; indeed, what is said about one species of this group may be said with very slight modifications about all. I cannot remember the circumstances under which I first examined one of these bewitching objects in the microscope, but it would probably be very early in my acquaintance with pond-life, for *Vorticellæ* are amongst the commonest of organisms, while at the same time they deserve to be ranked along with the loveliest. Rarely have I been disappointed when I have desired to point out to my friends one of these creatures in my gatherings from the pond. They occur in colonies usually, the bell-shaped animalcule being supported by a long slender stalk which springs out of the floccose material that has gathered upon the water-plant. *Nitella* and *Anacharis* are common habitats of *Vorticellæ*, but I have found them on other vegetable organisms.

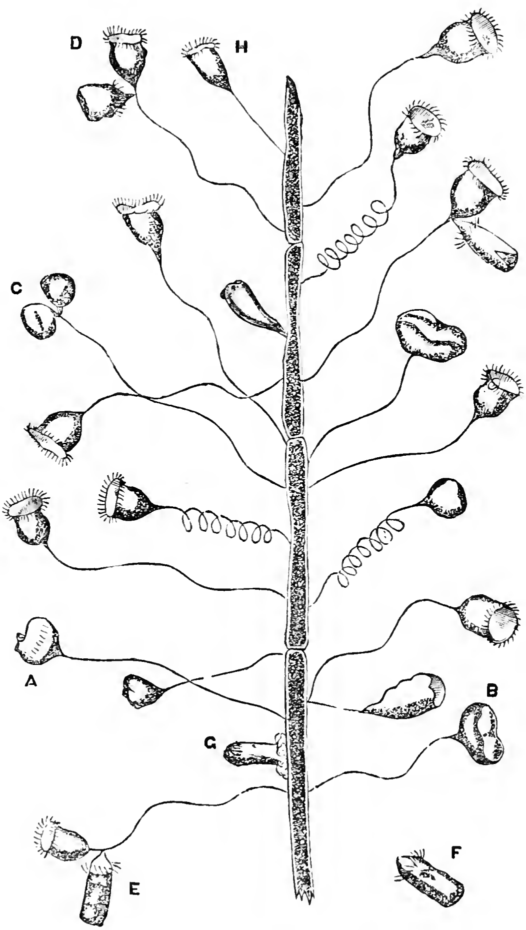
Let us look at our cluster of elegant vases through a half-inch objective. We shall at once see that curious vibration of the cilia around the top or rim of the bell, which is characteristic of the Rotifers, and which might lead us to imagine that *Vorticella* was a Rotifer, but such a mistake would soon be rectified by searching for the distinct head, eyespots, nerve ganglion, and highly organised digestive apparatus, which distinguish Rotifers, for all these are entirely absent from *Vorticellæ.* The latter evidently stands on a lower scale than the Rotifers. It is placed by zoologists in company with *Amœba*, and such little forms in the sub-kingdom *Protozoa; Vorticella* being one of the *Ciliated*

Protozoa, whereas Rotifers, as previously explained, are grouped amongst the *Scolecida*, or lowly worms.

The only movement *Vorticella* seems capable of, apart from ciliary vibration, is a curious action of the stalk. Every few moments you can see one of the slender stalks suddenly twist itself into a spiral or corkscrew pattern, thus bringing the vase close to the plant on which it lives, but very soon the stem lengthens out again, and the cilia once more resume operations.

Taking now a higher power it is possible to discern that the cilia are set around the inner rim of the bell, and that when in full activity they produce a couple of tiny round vortices outside the organisms; hence the name *Vorticella* or vortex-making animalcule. You can also distinguish the mouth, œsophagus, and orifice for the rejection of undigested food. No intestinal canal has been discovered, but the food on leaving the œsophagus goes to various parts of the sarcode and a temporary stomach may be set up anywhere. With oblique or dark-ground illumination some other interesting facts can be made out. The vases are not open at the top, as might at first be supposed, but they possess a retractile cover, on which the cilia rest. The stalks, too, are hollow or tubular, and are probably moved by some sort of rudimentary muscular structure. Sometimes a nucleus of granular structure is observed, which is thought to be an ovary, while there is also a contractile vesicle which may be concerned in respiration. These are usually made visible by adding a minute quantity of pigment, carmine, or indigo, to the water in the cell in which they are being exhibited.

Several of the individuals of our colony are gradually assuming pronounced differences of shape, even while we are observing them. Some leave their stalks and enjoy a sort of independence, while others tuck in their cilia, which are absorbed into the sarcode (*A*); grow uneven (*B*); and separate into two distinct vases (*C*); which develop a new set of cilia (*D*, *E*); the young individual at length breaking away (*F*); and after a brief enjoyment of wild liberty rooting itself on the plant (*G*); thus founding another colony. It would require several hours of patient and continuous watching to trace the same individual through all these transformations, but it is not very difficult to discern all these stages in a large colony. Mr. Slack describes three modes of reproduction amongst *Vorticellids*—(1) fission, or division of the body; (2) budding, analogous to the growth of plants; (3) by reproductive germs.



The organism named *Acineta mystacina*, by Ehrenberg, was said by Mr. Gosse to be merely one of the developmental stages of a larger Vorticellid. It is a "stiff and motionless object," with "tufts of flexible, but inanimate threads" taking the place of the stalked bell of the perfect creature, and a larger mass or tufted stalk protruding from one side. "From this condition two widely different results may proceed." In the one case a nucleus develops into a perfect *Vorticella*, which at length breaks out of the *Acineta*, while in the other case the nucleus "breaks itself up into a great number of tiny clear bodies, resembling Monads, which soon acquire independent motion, and glide rapidly about the cell formed by the inclosed Vorticella-body, as in a little sea." "By-and-by, this body, together with the *Acineta* wall, suddenly bursts, and the whole group of Monad-like embryos are shot out, to the number of thirty and upwards. The *Acineta* now collapses and disappears, having done its office, while the embryos shoot hither and thither in newly acquired freedom . It is assumed, on pretty good grounds, that these embryos soon become fixed, develop stalks, which are at first not contractile, and gradually grow into perfect Vorticellæ, small at the beginning, but capable of self-division, and of passing into the *Acineta* stage, and gradually attaining the full size of the race."—(Gosse's *Evenings at the Microscope*, p. 491.) This speculation of Mr. Gosse's, however, is not adopted, and *Acineta* is generally placed in the order of *Suctorial Infusoria*, which follows the *Ciliated Infusoria*. Amongst the *Ciliata*, and therefore closely allied with *Vorticella*, are the well-known *Paramæcium*, *Epistylis*, *Vaginicola*, and *Stentor*, all of which are common enough.

ARTIFICIAL SEA-WATER.—

Common Salt	...	...	1·325	parts.
Magnesium Sulphate	...	...	100	,,
Magnesium Chloride	...	...	150	,,
Potassium Sulphate	...	...	60	,,
Water ...	...	About	50·000	,,

Dissolve each of the ingredients separately and mix the solutions. Let stand for some hours, and finally add the balance of the water. Test the specific gravity of the mixture, and if over 1·027 add enough fresh water to bring to this point.

Among the Sea Urchins.

PART II.

BY GEORGE SWAINSON, F.L.S.

Plate XVIII.

IN our last paper we promised to continue the account of the Sea Urchins, with a description of the mouth and digestive system; but before doing so we must describe our more recent search for living forms of the small Heart Urchin (*Echinocardium cordatum*), of which we described the characters when dead on page 13, under the old name, which Forbes gave it, *Amphidotus cordatus*. It is to be met with cast up, dry and brittle, along most sandy beaches, and any naturalist visiting our Lancashire seaside resorts who will follow a high tide out to its lowest recess and dig there will be almost sure to turn up the living forms of this beautiful Urchin, which can be kept alive in a glass jar for a length of time sufficient to study it with interest. There is a large sand-bank opposite the end of St. Anne's pier, which stretches away towards Lytham and Preston, and is very dangerous for navigation. Our readers may perhaps remember the terrible disaster which occurred on this bank nearly four years ago, when the lifeboats belonging to St. Anne's and Southport were both wrecked and their crews drowned in an attempt to rescue the crew of the ship *Mexico*, which had struck upon these banks.

After crossing over this bank one warm afternoon in May, we commenced digging in one or two likely spots, hoping to find the rare, wormlike Holothurian, *Synapta inherens*, which, however, has never been recorded as found on these shores. It is well known among microscopists for the beauty of its plates and anchor-like spicules with which its skin is studded. It was, perhaps, a forlorn hope, but we were encouraged to persevere in our search by the fact that on three different occasions during the months of April and May, this year and last, we have taken in our surface-net off

St. Anne's pier the larval form of this curious Holothurian. This larva, for which at first we had some difficulty in finding a name and description, is a most interesting microscopic object, moving across the zoophyte trough with a curious gliding motion, evidently caused by the action of the cilia with which it is encircled. Our digging exertions, though unsuccessful in our main object, were, however, rewarded with turning up many of our old friends, the sea-eggs (*Echinocardium cordatum*), with their hair-like spines moving in every direction. Especially noticeable were the strong, spoon-shaped spines with which they can so quickly hide themselves under the sand. These Urchins, like the rest of the *Spatangidæ* family, have no teeth, the large mouth-opening being contracted by a buccal membrane, through which the creature sucks in the sand, from which it extracts minute particles of food, passing the sand through its intestine in a manner very similar to that of the earth-worm, and discharging it from the "periproct,' which is high up in the posterior, just above a most curious plastron, or ornamental space, surrounded by a "fascicle" of tiny spines. There is another fascicle or granular band of close-set, tiny spines and pedicellariæ on the upper side of the shell, which, though ornamental, is not so distinctive as the fascicle forming the "Fiddle" on *Brissopsis larifera* (Pl. I., Fig. 1). There is no doubt that these fascicles act as screens to prevent refuse from interfering with the action of the tube feet.

Since our article in January last, we have been at considerable trouble to look through the bibliography of the Echini, especially those of foreign authors, and although the calcareous rosette shown in Pl. I., Fig. 2, is often referred to and fully described, as well as the spicules, we found it is only illustrated by single plates, as in Fig. 3. We have, therefore, thought the structure so beautiful as to be deserving of a more elaborate drawing. which is presented in Pl. XVIII., Fig. 1. This calcareous disc of the pedicel or sucker-foot consists of from four to eight wedge-shaped plates,* riddled with holes, the outer edge of which, though beautifully

* Agassiz states that the sucker-discs have only four plates (*vide* "Revision of the Echini," 1874, p. 700). The greatest number of specimens examined by us had six plates; from our preparation of one of these our illustration was drawn.

indented, is not at all like the woodcut in Taylor's "Half-hours at the Seashore," which is the only drawing we have ever seen of it. The indentations, in fact, are points of continuous growth, always irregular. The muscular coating of the sucker covers the plates, entering the perforations and binding the whole together; while immediately under the terminal disc plates lie an equal number of oblong plates, forming a circlet or calcareous ring (Pl. XVIII., Figs. 2 and 3). Fig. 4, Pl. XVIII., is an enlarged drawing, showing how they fit on to each other. The muscular flesh, penetrating the pores, holds them *in situ*. This circlet, though, we believe, it was never before drawn, is called by Luvén the "*foot-ring*," "*annulus*," or "*psellion*," and forms the passage up the tube, the spicules referred to on p. 17 supporting the muscular flesh above.

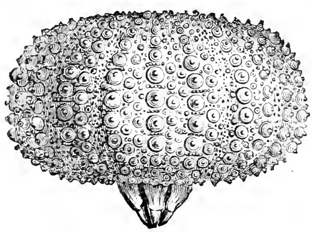


Fig. 3.—Buccal armature of *Strongylocentrotus lividus*.

But we must now introduce our readers to the masticatory apparatus of the "Regular" Echini, as those Sea Urchins are called whose rounded tests possess on the under side those powerful teeth which enable some of their possessors to carve out for themselves round holes or depressions even in the granite rock where they are safe from the fury of the Atlantic gales, as we found them in the north of Ireland last summer. In the above illustration, Fig. 3, the tips of the teeth are seen projecting from the shell of the Purple Sea

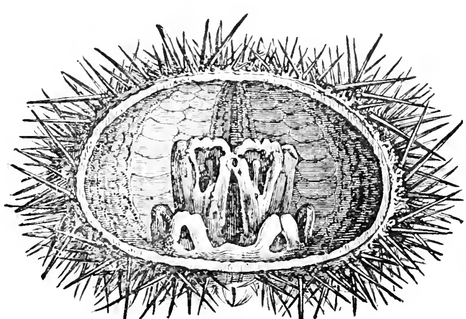


Fig. 4.—Interior of Test, with Dental Pyramid of Purple Sea Urchin.

Urchin, *Echinus lividus*, as it was formerly called, but the spines have all been removed, the tubercles or bosses on which they rotate alone appearing.

Our next illustration gives a view of the shell cut open with the spines still on. The tips of the teeth can just be seen below the shell, meeting in a point, but the upper portion of the jaws can be seen *in situ*, though not so well as in the illustration on p. 15, Fig. *C*, in our previous article. The jaws are composed of five triangular pyramids (Fig. 3), through each of which runs a grooved, pointed tooth; these meet in the centre of the buccal membrane, shown at Fig. 5, Pl. XVIII. The constant wearing away of these calcareous teeth is provided for at the upper or basal end, where the new growth forms, which is enamelled as it descends lower down. The jaws are in muscular contact at their sides, and from all parts of the dental pyramid a complicated set of muscular bands, working through the "auricles," give to the jaws great contractile power and capability of motion and grip.

In the illustration, Fig. 4, are to be seen the arch-like *auricles*, or "perignathic girdle," formed within the lower portions of the shell proper, and intended for the support of the whole dental apparatus, while through the arch-like openings proceed the five radiating canals connected with the tube-feet. By cutting round the peristomial margin of the shell, shown at *f* on p. 15, Fig. *C*, with a penknife within the perignathic girdle, it is easy to penetrate the skin of the buccal membrane, and take out the entire mass, or "Aristotle's Lantern," as this singular structure was formerly called; for this membrane is only strengthened by numerous small plates, magnified in Fig. 6, Pl. XVIII., though these imbricated plates increase in number at the coronal edge of the test. There are, however, on this membrane numerous pedicellaria and tentacles, especially ten large sensitive ones, called the buccal tentacles, which are protruded through the ten buccal or actinal plates which surround the mouth, drawn, at Fig. 5, Pl. XVIII., from one of my own preparations. The tentacles and much of the muscular flesh of the membrane was first dissolved away in liquor potassæ; but what is left makes a polariscopic mount of surpassing beauty. Around the margin of the membrane, where it joins on to the coronal plates of the test, there were in this specimen (*Echinus esculentus* or *sphæra*), as in most of the regular Echini, five pairs of external branchiæ or oral gills, which, being very feathery and thin, assist in respiration, for they are ciliated internally and communicate with the water vascular system within the test, which is thus kept oxygenised. No young naturalist ought to miss the interesting sight which is gained by placing the mouth portion of a small echinus under the microscope with a good top light, as he will thus obtain more practical knowledge of the wonderful construction of this walking ball than by any drawings or descriptions, however lucid.

Referring again to the woodcut, Fig. *C*, on p. 15, the teeth, which are quite soft at the top and bend over, are seen going down the centre of each pyramid. At Fig. *A* are seen the plates of the summit of the masticatory apparatus, *d*, and some of the striated muscles, *e*, while above each "brace" dividing the pyramids are long bifid processes, called the "compass-pieces" or "radii." Each brace radiates from the central axis of the jaws and joins in its lower portion the curious "perignathic girdle," formed inside the test in alternate ridges and arches, beneath which latter the radiating, ambulacral canals, shown on p. 15 at *g g* in Fig. 2, *C*, have, as we have said, sufficient space allotted them.

The teeth move in a circle around the opening of the gullet, which passes upwards through the "lantern," and is continued into an elongated alimentary canal, shown at *a*, in Fig. A, on page 15. This intestine winds from left to right, being coiled spirally around the interior of the shell, and is kept in position by mesenteric bands and filaments, terminating at the "periproct," or anal aperture, *Fig. C*, *a*, on page 11.

The partially digested food found in the stomach consists of pellets of algæ, etc., and this confirms our idea that the *Echini* were feeding upon the sea-weed when we watched their proceedings so closely in the deep cavern to the south of Port Erin Bay.

The surface of the mesenteries, as well as the lining membrane inside the shell, is thickly ciliated, and this, no doubt, is helpful in circulating the richly amæboid fluid, filling the test, as well as assisting in respiration. The regular Urchins possess two principal blood vessels, one round each end of the alimentary canal, and also a kind of heart; the latter is the oval canal, shown at *b*, in Fig. A, page 15, and is enclosed in the same groove with the sand canal "*c*" of the madreporic filter; but the irregular Urchins (*Spatangidæ*, etc.) seem to have no organ of that nature. The sexes are distinct in all Echinoids; the reproductive organs filling the internal spaces between the ambulacral pores, and communicating with the exterior through the apertures in the genital plates, Fig. C, *g*, on page 11.

We must now, in conclusion, proceed to deal with the developmental history of the Sea Urchins, which, in some respects, is more interesting to the microscopic student than that of any other sub-kingdom. From the ovum proceeds, after segmentation in the usual way, a ciliated oval "planula," which soon differentiates a bilateral symmetry, with ciliated shoulder-plates so unlike the parent form that for long the *Pluteus* larva was believed to be a distinct genus of marine life.

It is extremely difficult to follow every step in the life-history of the Echinus larvæ, as they take very badly to aquarian imprisonment. We have often caught them and kept them for days, but they sink to the bottom of the glass and soon dissolve away, lacking apparently the boisterous heaving motion of the open sea, sparkling with oxygen.

In a previous article ("Wesley Naturalist," Vol. III., page 71) we described a lazy, though most enjoyable way of surface netting for Echinoderm larvæ, etc. We have tried another method with much greater success. Take a cone-shaped net of fine muslin, 1 foot diameter of ring, say a yard long; fasten the small end (open) round the neck of a two-ounce bottle of clear glass. You must then place yourself on a point of jutting rock, or pier end, when a strong tide is running in briskly, and gradually sinking the bottle and net, hold it high or low to get varying samples brought by the incoming flood-tide. If it has been a warm sunny morning in June or July, you will generally find a number of these "pluteus" forms along with a few small jelly fish and innumerable crustacean zooeæ and copepoda, with possibly one or two "tadpole" larvæ of *Ascidians*, that curious link of connection between the two great kingdoms of vertebrata and invertebrata, which is such a prize to most naturalists.

We have recently taken several of them off St. Anne's pier, as well as four different varieties of Echinoidea larvæ (*E. esculentus*, *E. miliaris*, *E. cordatum*, and one species we were unable to name). This latter had already begun to evolve the first part of the future echinoid shell or test, the buccal plates of the future mouth being just perceptible. It is only by taking a number of these species in varying stages of their nomadic pluteus life, that scientists have been able to follow their "strange, eventful history," which I shall now proceed to describe, for towards the end of the larval condition only a few hours are required for the absorption of the flesh and entire calcareous scaffolding, and the production of a young echinus differing greatly from the complicated larva, and yet still unlike the mature animal, for the round shell is gradually built up, plate after plate and spine after spine, from a minute buccal membrane, Fig. 5, Plate XVIII.

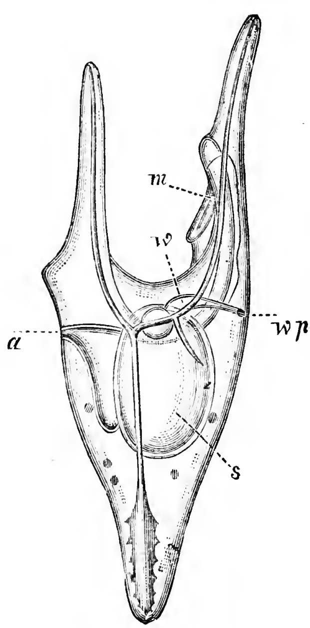


Fig. 5.—Pluteus Larva of Purple Sea Urchin (*Strongylocentrotus lividus*).

If the accompanying woodcut of the "*Pluteus*" larva of the Purple Sea Urchin, from the west coast of Ireland, is turned upside down, the likeness to a fireman's helmet will be noticed, as it is drawn in profile; but if you will now turn to our January illustration, Plate I., Fig. 5, and turn it also upside down, for our artists seem to have a difficulty in sketching these forms the right side up, you will perceive the similarity, which the late P. H. Gosse was the first to notice, to a painter's easel, when looked at full in the face; for, he says,* "it consists of four long legs or rods, arranged two in front and two behind, with connecting pieces going across in a peculiar manner, and meeting at the top in a slender, pointed head." "The whole calcareous framework is invested with a clear gelatinous

* Gosse's *Tenby*, page 282.

flesh, within which is a large oval cavity"—the stomach (*s.*), which, singularly, is the only part of the larval form not absorbed and lost in the curious development which soon takes place. The size of the creature is very small; only as large as an ordinary period (.). The mouth is seen at *m.*, the anus at *a.*, while *w.p.* is the external water-pore-opening, leading into the water vascular ring, *w.* This tiny creature is beautifully ciliated, especially down the legs, as we may call them, and on two "epaulettes," one on either side, just above the anus and water-pore in the woodcut, and close to the figure 5 in the plate, which, being drawn from one of my own microscopic mounts, does not show them as in life. Dr. Carpenter, in his work on the Microscope (last edition, p. 646), gives excellent directions as to the best method of mounting these larvæ, quoting the authority of Mr. Percy Sladen, Secretary of the Linnean Society. No mount, however, can give the beholder an idea of the regular, easy, and beautiful motion with which these minute forms of life thread their way through the mighty waters of the trackless deep, without compass or guide, until the instinct within them warns them to seek a lower and safer level for further development in their life history.

Space forbids much reference to the family affinities of the Sea Urchins. Agassiz considers there is a close structural relationship between the Echinoderms and the Ctenophoræ (Cydippe, etc.), while there is an idea, originated by Haeckel and lately strongly supported by Gegenbaur, that the Sea Urchins are composite creatures, being, in fact, colonies of worms. There is certainly a curious resemblance in the larval development of some of the Gephyrean worms and those of the Holothurian and Starfish Echinoderms.

There is, however, this important difference, that the worm-larva becomes *transformed*, by successive moulting, into a worm; while the Echinoderm larva is absorbed and eaten up, as it were, by the growing young Sea Urchin, etc.

We may, however, be certain that in these larval similarities we find the true evolutionary missing links between the otherwise greatly divided families with which the Creator has peopled our globe.

EXPLANATION OF PLATE XVIII.

Fig. 1.—The Calcareous Rosette or disc of sucker foot of *Echinus esculentus*, showing the foot-ring or "psellion" *in situ*, × 100.

,, 2 and 3.—Loose plate of the "psellion," showing the calcified areolar condition, × 200.

,, 4.—The plates of the Foot-ring as placed in position, × 250.

,, 5.—The buccal membrane surrounding the teeth of *Echinus esculentus*, with the ten buccal plates *in situ* (the tentacles proceeding therefrom being dissolved away in liquor potassæ), × 6.

,, 6.—One of the imbricated plates from the surface of the buccal membrane, highly magnified.

Food from Wood.

Probably no modern science presents a wider field for speculation than that of chemistry, and more especially, perhaps, that branch of the science which treats of organic compounds.

In an address delivered at Heidelberg by no less eminent an authority than Victor Meyer, it is announced "that we may reasonably hope that chemistry will teach us to make the fibre of wood the source of human food." What an enormous stock of food, then, will be found, if this becomes possible, in the wood of our forests, or even in grass and straw. The fibre of wood consists essentially of cellulin. Can this be made to change into starch? Starch has essentially the same percentage in composition, but, as every one knows, it differs very much in its properties, and the nature of its molecules is probably much more complex. Cellulin is of little or no dietetic value, and is not altered, like starch, in boiling water. It readily gives glucose when treated with sulphuric acid, as is easily shown when cotton wool, which is practically pure cellulin, is merely immersed in it. Starch gives the same product when boiled with weak acid.

The author further quotes the researches of Hellreigel, which go to show beyond dispute that certain plants transform atmospheric nitrogen into albumen, and that this process can be improved by suitable treatment. The production, therefore, of starch from cellulin, together with the enforced increase of albumen in plants, would, he adds, in reality signify the abolition of the bread question. It must be borne in mind, however, that theory, fascinating and promising though it may be, is not always capable of being followed up by a practical result.—*Kuhlow.*

J. Horrell del ad nat

Sea-Urchins

The Elements of Microscopy.

I.—The Instrument—(*continued*).

By C. E. Bousfield, L.R.C.P., M.R.C.S.

THERE is another method of employing the concave mirror, which is extremely valuable when intense illumination of moderate angle is required. It consists in placing the mirror at its principal focal distance from the object, and interposing between the lamp and the mirror the ordinary bull's-eye condenser. The bull's-eye is so placed that the flame is in its principal focus, and by this means parallel rays are thrown on to the mirror and are brought to a focus upon the object. To obtain the full advantage of this method, the lamp should be placed by the side of the stage of the microscope, and upon a level with it. If this is not done, much light is lost, in consequence of the mirror being placed at a considerable angle with the stage ; whereas by the suggested arrangement, the light returns almost along the same path by which it travelled to the mirror, and the latter, being turned nearly full on to the stage, offers the greatest possible surface for reflection and condensation. The concave mirror has not hitherto received the attention it deserves in its applications to the microscope, and it will well repay any time spent in acquiring a thorough knowledge of its properties. By its use under proper conditions results may be obtained which will challenge comparison with those got from a low-angled, sub-stage condenser. When, however, the concave mirror forms a large part of the surface of a sphere, the rays are no longer brought, even approximately, to a point, and it is consequently of very inferior utility for objectives higher than a low-angled half-inch to a simple substage condenser. Of these there are many, varying in price from fifteen shillings to as many pounds. For the beginner we would recommend a simple form, constructed by Baker and sold at the price first mentioned. We cannot, however, refrain from referring to the splendid condenser made by Zeiss, which can be purchased complete, with iris diaphragm, for £3 10s. The addition of a substage condenser renders the microscope an "instrument of precision," and its use must, therefore, be undertaken under somewhat more stringent conditions than those which apply to the concave mirror.

In employing the latter, it is, on the whole, better to turn the *flat* side of the flame toward the mirror. In the use of the sub-stage condenser, however, the plane mirror is employed to reflect the image of the *edge* of the flame, and by focussing the condenser the image of this edge is made to coincide with that of the object. A narrow band of light is thus formed in the field, and furnishes the illumination which is, of all ordinary means, the most suitable and most searching for the testing of lenses, or for making out the precise structure of a difficult object. The band of light is not, however, suitable for the examination of objects which occupy the whole, or a considerable portion, of the field of view. The bull's-eye may, therefore, be employed as a parallelliser, the edge of the lamp-flame being placed in its principal focus.* The best point is found by putting the bull's-eye close to the mirror in the first instance, and moving it gradually farther away until the whole field is filled with light. If the centre of the mirror is in a line with the centre of the lamp-flame, no alteration will have to be made in the height of the bull's-eye as the latter is moved away, but it must be exactly in the line between the two and at right angles to this line.

The above remarks apply to the use of the bull's-eye in combination with some form of substage condenser, but the bull's-eye may also be used either, as above described, with the concave mirror or with the plane mirror. If the microscope is not fitted with a plane mirror, a circular piece of silvered plate-glass of the same size may be obtained from almost any glass-dealer, and if a cardboard frame, large enough to fit over the concave mirror, be made for it, there will be no difficulty in its use for any purpose where a plane mirror is indicated. It will be easily seen that the

* The principal focus of any lens is found by noting the distance from it at which a sharp image of the sun is formed, so that the *concave* mirror and the *convex* lens are alike in their effect upon the light which falls upon them, inasmuch as they cause parallel rays to converge, rays which converge already to become more convergent, and rays which diverge to diverge less or converge, according to the amount of divergence.

essence of the whole of the remarks on illumination hitherto made is that whatever method be employed, the light must be *brought to a focus* upon the object.*

Thus, then, the slide is first placed upon the stage, and some kind of light thrown through it; a low power is then focussed upon it, and the mirror, condenser (bull's-eye or substage, or both), and lamp so arranged that the whole field is well and evenly illuminated by the rays from the lamp, collected to a focus upon the object. The above remarks, of course, apply only to cases in which the object is to be viewed as a transparent one, by a gleam of light, of a conical form, thrown directly through it, and for most purposes this is amply sufficient. There are some objects, however, mostly extremely transparent ones, whose full beauty or structure can only be brought out by some form of what is called dark-field illumination. With an ordinary observation by direct illumination many rays enter the objective which have not really been affected by the object at all, viz.:—those which pass round it and those which pass through spaces on it, or perfectly clear portions of it. In dark-field, or, as we prefer to call it, oblique illumination, no rays enter the objective except those which really are sent into it by the object itself, its various portions acting as mirrors and deflecting the light which has fallen upon them. The absolute truth of the above statement depends, of course, upon the extent of obliquity of the illumination; the more oblique it is the darker the background. There are various ways of effecting this, the principle in all being the same, viz.—to secure the absence of direct rays entering the objective itself.

The simplest method, and for low powers as good an one as any, is to swing the mirror just far enough out of the axis of the microscope to bring about the desired result, and by careful arrangement it is not difficult so to arrange the lamp and mirror that the light from both shall be cast upon the object, and that neither shall throw any into the objective. This is best done by placing the lamp on the left-hand side and swinging the mirror

* The whole subject will be found treated at considerable length in my "Guide to the Science of Photo-Micrography." (London: Kent and Co.) Price 1s.

over to the right, so that they are at the ends of the base of a triangle of which the object occupies the apex, and the effect will be assisted by placing a black cloth under the microscope, so that no light may be reflected from the table. Or the bull's-eye may be brought into play by focussing the rays from the lamp obliquely on the underside of the object. If the obliquity is not sufficient, the field will not be quite dark, but it should not be greater than is required, or the object will lose greatly in brightness.

Other methods are the spot-lens and the paraboloid of Wenham. In the former the centre of the lens is blackened, so that only the marginal rays reach the object; in the latter, the apex of a paraboloid glass cylinder is cut off and the central portion blackened, so that all the rays which pass through the parabola parallel to the axis illuminate the object, being internally reflected, whilst the latter is itself seen on a black background. Some very beautiful effects are obtainable by the last appliance, and as its theory is perfect it is a pity that it only works in practice with low powers. The finest effects by far in dark-field illumination are obtained by stopping out the central rays in the cone of light from the substage condenser. Even in the simplest form, above described, the stops which are supplied with it give such perfect dark-field and such brilliancy to the object, as are far beyond the reach of a paraboloid or spot-lens, costing twice as much, and of no use for any other purpose, whilst with the higher grades of substage condenser, an image obtained by stopping out the central rays is almost as perfect as that given by the ordinary method, and comparatively high powers, as high as a 1/6th inch, can be used for observation of it. Whichever method, however, is adopted, the same remarks as before will apply to the necessity for bringing the light to a focus upon the object, and in conclusion we would impress the necessity of not using light of any greater obliquity than will suffice to make the background dark. With some extremely delicate objects there is very great advantage in *slightly* darkening the field, as it may happen that the details are drowned in a flood of light, and mere reduction of the light alone will have to be carried almost to the point of invisibility before they are apparent, whilst a very slight interruption of the central beam may suffice to throw them into high relief. This plan will often succeed with objects which are too transparent for ordinary dark-field methods, and will very much assist the definition of those whose structure is very transparent and colourless.

A word must be added in condemnation of a method which was a short time ago very fashionable, and still has some supporters, especially in America, the swinging substage—a substage condenser so arranged as to be made to throw the light obliquely upon the object. Of all methods this is the worst, since even an approximation to focus is impossible, and the loss of light by reflection is very great. We mention it only as a thing to be avoided.

(*To be continued.*)

Aspect of the Heavens: October, November, December, 1890.

By A. Graham, M.A., etc., Cambridge Observatory.

THE most striking phenomena in this interval are a partial eclipse of the Moon on November 26 and a total eclipse of the Sun on December 12: both invisible at Greenwich. The former may be seen in Asia and Australia and parts of Europe and Africa, the earth's shadow being projected a very little way on the moon's edge; the latter in the South Pacific Ocean, and as a partial eclipse in the southern regions of Australia.

Occultations of *Neptune* by the Moon may be seen at Greenwich on Oct. 2 from 9*h*. 46*m*. till 10*h*. 42*m*. in the evening; and on Dec. 23 from 9*h*. 7*m*. till 9*h*. 38*m*.

The phases of the Moon are:—Last Quarter—Oct. 5, 8*h*. 23*m*. aft.; Nov. 4, 4*h*. 13*m*. aft.; Dec. 4, 1*h*. 27*m*. aft. New Moon—Oct. 13, 11*h*. 5*m*. aft.; Nov. 12, 1*h*. 38*m*. aft.; Dec. 12, 3*h*. 11*m*. morn. First Quarter—Oct. 21, 5*h*. 37*m*. morn; Nov. 19, 0*h*. 45*m*. aft.; Dec. 18, 8*h*. 36*m*. aft. Full Moon—Oct. 27, 11*h*. 42*m*. aft.; Nov. 26, 1*h*. 23*m*. aft.; Dec. 26, 5*h*. 57*m*. morn.

Other occultations of *Neptune* will occur on Oct. 30 about 8*h*. morn and Nov. 26 about 4*h*. aft., and one of *Mars* on Oct. 20 about half-an-hour after noon; but none of these will be visible to us.

Mercury will be a morning star till Nov. 17, when it passes nearly behind the Sun from west to east, and will then be an evening star till the end of the year. It attains the greatest angular distance from the Sun westward on Oct. 15 and eastward on Dec. 28. About these times it may possibly be visible to the naked eye. The Moon will be near this planet on Oct. 12, Nov. 12, and Dec. 13.

Venus, as the evening star, attains its greatest brilliancy on Oct. 30. On Dec. 4 it passes, nearly between us and the Sun, from the east to the west side, and becomes the morning star. Seen through a telescope at any time during the quarter the form is a beautiful crescent, the diameter varying from 27 to 63 seconds. It is low in the south, the meridian altitude, early in November, being only a little over 10 degrees. The Moon will be near this planet on Oct. 17, Nov. 14, and Dec. 11.

A remarkably close conjunction of *Mercury* and *Venus* occurs on Nov. 29; at 7*h.* in the evening the angular distance will be only 10 minutes of arc, about a third part of the diameter of the Sun or Moon.

Mars is still low in the heavens, but gradually rising. It may be seen in the evenings low in the South-West. It will be in conjunction with the *Moon* on Oct. 20, Nov. 18, and Dec. 16. On the evening of Nov. 13, this planet will be very near *Jupiter*.

Jupiter is very conspicuous as an evening star. It is East of *Mars* until the conjunction on Nov. 13, when the latter overtakes it and soon leaves it behind.

Saturn is in Leo near the confines of Virgo; and is therefore a morning star. On November 29, it rises at midnight. It will be near the Moon on Oct. 10, Nov. 7, and Dec. 4. The ring is now very narrow—merely a line across the disc of the planet. The length is upwards of 40 seconds, two-and-a-half times the diameter of the globe, the width is less than 2 seconds.

Uranus will be in conjunction with the Sun on Oct. 20; on the 31st it will be in conjunction with Mercury.

Neptune, which is a few degrees West of Aldebaran, will be in opposition to the Sun on Nov. 27. On Nov. 24, it crosses the meridian at midnight, at an altitude of 58 degrees.

On Dec. 21, at 9 in the evening, the Sun attains his greatest southern declination, and the Winter quarter commences.

In Darkest Africa.

BY this time our readers have become familiar with Mr. Stanley's narrative of his travels and sufferings in connection with the Emin Pasha Expedition. The dreary half-year spent in cutting his way through the forest, the wearisome return to Banalya in search of Barttelot's rear column, the three journies to the Albert Nyanza Lake, the vacillations of Emin, the march to Zanzibar, every one has read about, and we have no intention of going again over this well-trodden ground. But there are many facts bearing on the natural history of Equatorial Africa, which are scattered about in Mr. Stanley's fascinating volumes, and which we think our readers will thank us for bringing out from the mass of incident and adventure by which they are, to some extent, obscured.

Has any light been thrown on the subject of man's origin? This is a question most of us have put to ourselves while reading the intrepid explorer's latest work. It has been said more than once that Stanley has discovered "the missing link." During his travels up the Congo, in 1874—7, it was reported that he had met with men who possessed tails, and it is still believed by some, not of course amongst the well-informed, that this really was the case. It turned out, however, that Stanley's references to this matter were nothing more than a report of certain myths related to him by Rumanika, an African romancist. Later on, in Uregga, he encountered a tribe whose chief food consisted of what the natives called "Sokos," *i.e.*, chimpanzees. As the skulls of their victims looked remarkably human, Stanley brought a couple of them home, and they were examined by Prof. Huxley. He declared that "nothing in these skulls justifies the supposition that their original possessors differed in any sensible degree from the ordinary African negro." The tribe in fact consisted of cannibals, but they were ashamed to confess it.

During his latest journey he came across a race of Pigmies, and these have been thought by some to constitute a sort of missing link between man and the lower animals. But there is absolutely nothing in Stanley's account of these curious people to warrant such a surmise. These Wambutti, as they are called, dwell in the region of the Ituri river. They live mostly on game, which they are very expert in catching. They vary in stature from three feet six inches to four feet and a-half. A full-grown adult weighs about ninety pounds. Their weapons are bows and arrows. They smear their arrows with poison made from a species of arum, and with them they are able to kill even elephants. They are very ingenious in laying snares for elephants, civets, and ichneumons. They collect honey and other produce, and carry on a rude commerce with neighbouring tribes. Their dwellings are "low structures, of the shape of an oval figure cut lengthways; the doors are from two feet to three feet high, placed at the ends," and are arranged in a rough circle. The queen of the Pigmies is described as wearing iron ornaments, and as having a quiet, modest demeanour, and being altogether a very pleasing little creature.

Mr. Stanley is not a naturalist, and he did not allow his attention to be diverted from his main business by making collections, but he has given much useful information on points of natural history and geography. We learn that he met with numerous members of the *quadrumana* order, such as chimpanzee, baboon, lemur. "Now and then troops of monkeys bounded with prodigious leaps through the branches, others swaying by long tails a hundred feet above our heads, and with marvellous agility hurling their tiny bodies through the air across yawning chasms, and catching an opposite branch, resting for an instant before burying themselves out of sight in the leafy depths." Then there were buffaloes, antelopes, gazelles, zebras, wild cats, boars, squirrels, hippopotamus, rhinoceros, elephants, rats, mice, coneys, etc.

Reptiles were represented by tortoise, water snakes, whip snakes, pythons, puff adders, and horned snakes. It is remarkable that there were so few casualties from snakes, only one or two of the men having been injured during the whole of the journeyings.

Of Amphibia, only frogs are mentioned, which in many places made the night discordant with their croaking. Fishes are only scantily referred to, for there was no leisure to observe them. Such as are mentioned are of the siluroid type.

Of birds vast numbers were seen, but the density of the forest protected them from capture. Parrots, parroquets, ibis, touracos, sun-birds, swifts, finches, shrikes, whip-poor-wills, hoopoes, owls, guinea fowls, black-birds, weavers, kingfishers, divers, fish-eagles, kites, wagtails, herons, bee-eaters, pipits, sand-pipers, cockatoos, horn-bills, jays, barbets, woodpeckers. pigeons, and numerous small birds, are recorded. In the grass lands the vulture was observed.

The natives do not seem to turn their attention to the domestication either of mammals or birds. Goats and pariah dogs, however, were found with man. Only one cat was seen in captivity, and that was a wild one in a cage.

The rivers abounded with bivalves, oysters, and clams, and the heaps of shells seen at various places showed that the natives understood the value of a molluscous diet. Slugs and snails occasionally formed part of the food of Stanley's starving men.

Insect life, as may be supposed, is very prolific in the tropical forest. Bees, wasps, whose graceful nests hung from the trees, moths, butterflies, house-flies, tsetse, mosquitoes, gadfly, gnats, beetles of enormous proportions, crickets, cicadæ, and others, were met with in swarms. At Fort Bodo especially, the red ants were a great plague. "In long, thick, unbroken lines, guarded by soldiers on either flank, they would descend the ditch and ascend the opposite sides, over the parapets, through the interstices of the poles, over the banquette, and down into the plaza of the fort, some columns attacking the kitchen, others headquarters; and woe betide any unlucky naked foot treading upon a myriad. Better a flogging with nettles, or cayenne over an excoriated body, or a caustic bath for a ravenous itch, than these biting and venomous thousands climbing up the limbs and body, burying themselves in the hair of the head, and plunging their shiny, horny mandibles into the flesh, creating painful pustules with every bite." Some perverse and undisciplined tribes would drop from the roof in such numbers that they had to be destroyed by throwing hot glowing embers upon them. Fleas and other disagreeable insects abounded in the vicinity of the native huts.

The Jigger Flea (*Pulex penetrans*) was also very troublesome. It makes its way under the skin, especially of the toes, and lays its eggs there, thus causing terrible ulcers in the flesh.

The flora of Central Africa is of far greater diversity than its fauna. Lieut. Stairs, in his ascent of Mount Ruwenzori, gathered members of no fewer than thirty-eight genera, including Clematis, Viola, Impatiens, Rubus Vaccinium, Begonia, Senecio, Erica, Carex, and many ferns and lycopods. In the forest occurred palms (Elais, Raphia, and Calamus), teak, camwood, mahogany, lignum vitæ, iron-wood, stink-wood, ebony, copal wood, wild mango, orange, wild fig, butter-tree, acacia, and numerous other trees.

Those plants which afforded food to the expedition were of most interest to Stanley, and in some localities were found in considerable numbers. Chief amongst these were the banana, plantain, and manioc, or cassava, the fruits of three species of musa, the berries of phrynium, the fruit of *Amomum*, and nux vomica. Fungi were common, but for want of accurate knowledge they were only eaten in times of famine, and then occasionally with unfortunate results. The Castor Oil plant grows at the edges of the forest, and some of the tribes cultivated tobacco. Many of the native tribes cultivated corn, which matures with extraordinary rapidity, and the garrison at Fort Bodo, during Stanley's long absence while searching for the rear column, grew large quantities, as well as potatoes, etc. Nothing but industry, and a settled government, is needed to convert the hundreds of miles over which the expedition travelled, often on the verge of annihilation for want of food, into a fruitful garden. Perhaps these conditions will soon be realised; at any rate these latest efforts of the veteran explorer have made the future of Africa appear full of promise. It must be a matter for intense gratification to him that the leading nations of Europe have at length agreed upon a large project for the development of the vast sources of wealth which he has opened up in the very heart of the Dark Continent.

These gatherings from Stanley's pages, through which they are scattered without any attempt at systematising, afford a glimpse of the treasures that await the student of natural history who shall hereafter explore these unknown regions under circumstances favourable to observation. We cannot but regret that there was not a naturalist attached to the expedition, and yet probably he could not have done more than merely tabulate what he would have seen, for it would have been next to impossible to convey specimens along such a route and under such disadvantages. Emin Pasha is an accomplished botanist, entomologist, ornithologist, and geologist, and it is to be hoped that he will before long give the world the benefit of the vast accumulations of notes which he has for many years been making.

Had space permitted we should have referred to the geographical problems touched upon, for it is here that Stanley has done his best work. The Nile and Congo watersheds were determined by him years ago, and now many of the large tributaries of these majestic rivers are understood. The lakes in the vicinity of Emin's seat of government have been thoroughly explored; the problem of the mountains of the moon, as old as Ptolemy, has been settled; and the character of the vast region between the Atlantic seaboard and the Indian Ocean determined. The maps which accompany the volumes are valuable and permanent contributions to our knowledge, and one glance at them is enough to indicate the vast labour expended in their production, as well as to demonstrate the importance of Stanley's careful survey of the country to the commerce, politics, and science of the future.

Change of Address.—The address of the Rev. William Spiers, is now 329, Beverley Road, Hull.

The Rev. W. Spiers has received from Mr. A. Chopin several flints which were found during the Wesley Scientific Society's recent excursion to the Isle of Man. They were met with near Port-St.-Mary, and are undoubtedly artificial. There seems to have been no record of such flints having been found in that precise locality before. Mr. Spiers has sent a communication on the subject to the Isle of Man Natural History Society.

Selected Notes from the Society's Note-Books.

To Mount Insects without Pressure.—Mr. Staniforth Green, of Ceylon, is a great proficient at this style of mounting. The accompanying slide of Head of Blow-Fly shows the internal structure, and also the proboscis in its natural position. The method of treatment is to kill the insect in turpentine, which is afterwards heated, causing the protrusion of tongue and ovipositor and the expulsion of air from the spiracles. The insect is left in the turpentine for any length of time that may be required to produce the necessary transparency, and mounted in balsam without pressure. Small insects, such as gnats, do not require the turpentine to be heated, and for these camphine is to be preferred. If it is required to arrange the legs, etc, this should be done very soon after the insect is killed, as it soon becomes rigid.

J. E. Ingpen.

Coccus cataphractus ("armed at all points") (Pl. XIX., Figs. 1, 2, 3).—The Mailed Coccus was found in wet moss. When living, it has a beautiful ivory-white appearance, suggestive of relationship with the Wood-lice, the little crustaceans found among decayed wood. I think it is not very common, as no one appeared to know them. But they are figured and described in Shaw's Zoology, 1817. I do not think they would be classed with the Scale insects now. H. E. Freeman.

Gomphonema germinatum is peculiar to streams in mountainous countries. It is remarkable for the extreme development of the stipes. The frustules are attached to the smaller of the two knobbed ends, like flowers, to the summits of long, stout, tough, branching filaments, which are matted together into sponge-like tufts an inch or more in diameter. H. F. Parsons.

Fronds of Ferns.—I cannot understand why the leaves of ferns should be commonly called "fronds." A frond, or "thallus," is the term applied to the vegetative expansions of plants which have no distinction between *stem* and *leaves*, as liverworts, lichens, algæ, etc. Ferns have distinct stems, and their leaves correspond in structure to those of flowering plants. The leaves of plants lower in the scale than Ferns, as Mosses and Jungermanniæ, are always called "leaves," not "fronds." H. F. Parsons.

Cuticle of Stangeria paradoxa.—I do not know this plant, but I fancy it is one of the *Cycadaceæ*. The thick walls of the epidermic cells are very curious. I notice that the stomatic cells do not polarise, while the rest of the epiderm does. In Osmunda the stomata are the only parts of the epidermis that do polarise.

H. F. PARSONS.

Stangeria paradoxa.—Dr. Parsons is correct in supposing this plant to be a Cycad. It is most nearly allied to *Zamia*. Its specific name was probably given to it because, although having leaves like a Cycad, the venation of them is more like a fern. It is a native of South Africa, was first brought to England in 1861, and named after Dr. Stanger, of Natal. One would desire every reasonable honour and credit to distinguished and worthy naturalists other than giving their names in a quasi-Latinised form to plants. The practice is objectionable when such names are merely the specific ones, but still more so when given as generic names.

WASHINGTON TEASDALE.

Coccus cataphractus (Pl. XIX., Figs. 1, 2, 3).—I happen to have Shaw's book with the plate of *Coccus cataphractus*, and have traced it for the benefit of those who have not access to the book. The drawing showing the underside has some of the armour removed near the anus to show the wrinkled appearance of the abdomen; an egg is also represented on the plate.

C. F. GEORGE.

Tracheæ of Insects.—Can any member suggest a means of colouring the tracheæ of insects so as to show their ramifications through an insect? If this can be done and the insect mounted "solid," the slide would be a very instructive one. C. ELCOCK.

Fronds of Ferns.—In defence of the term "frond" applied to the leaves of ferns, I must say that as it means "a combination of leaf and stem," it appears to me more appropriate to ferns than to liverworts, lichens, or algæ. At the same time, I know that the term has been objected to by some botanists, who do not, I think, sufficiently consider the association of organs that in other plants are simply conservative, with the reproductive functions in ferns, which is a feature sufficiently remarkable to justify the distinctive term, and has thus been almost universally adopted.

E. E. JARRETT.

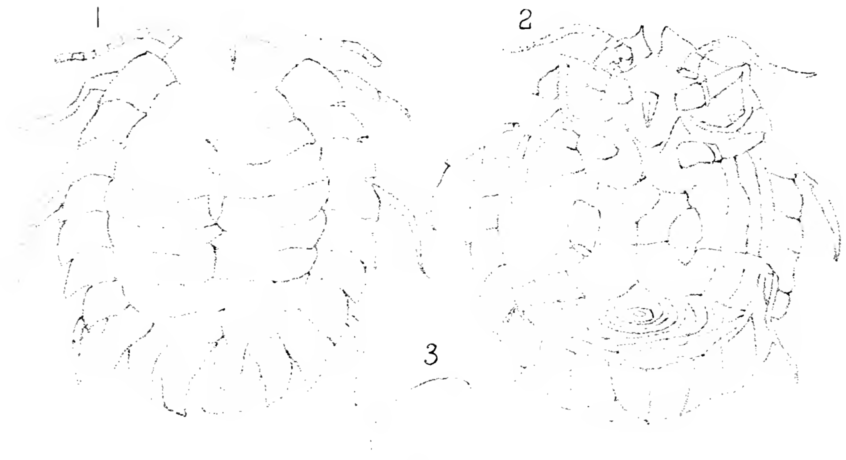
Stangeria paradoxa, though rightly included in the *Cycadeaceæ*, is a genus quite distinct from any other of the order in its fern-like foliage. It is a Natal plant, with a thick napiform trunk, a few coarse pinnate leaves, the perina of which resemble a Tomaria in being traversed by parallel forked veins. The fructification is in cones, male and female on separate plants. Only this one species is known. E. E. JARRETT.

Unopened Eyelids of a Kitten (Pl. XIX., Fig. 4).—In this figure *a* represents the Meibomian glands; *b*, inner surface of eyelid; *c*, bulbs of eyelashes. The two dark patches at the juncture of the eyelids are groups of pigment cells. The Meibomian glands secrete an unctuous matter which prevents the eyelids sticking together, and which often collects in sensible quantity on the edges of the eyelids during sleep, especially when glandular action is excited by slight inflammatory irritation. In the human eyelids there are about forty of these glands in the upper lid and a smaller number in the lower. A. H. SEARLE.

Section Piper (Pl. XX., Fig. 1).—Double-stained sections are very beautiful, and might be very instructive if information were supplied with them as to the structures they exhibit. Why do some tissues take one colour and others the other? I suppose it is owing to some difference in the chemical constitution of the cells, etc. This specimen differs from one that came under my notice a short time ago, chiefly in having a well-defined band of thick-walled cells coloured blue between the outer and inner rows of fibro-vascular bundles. What is this? A. HAMMOND.

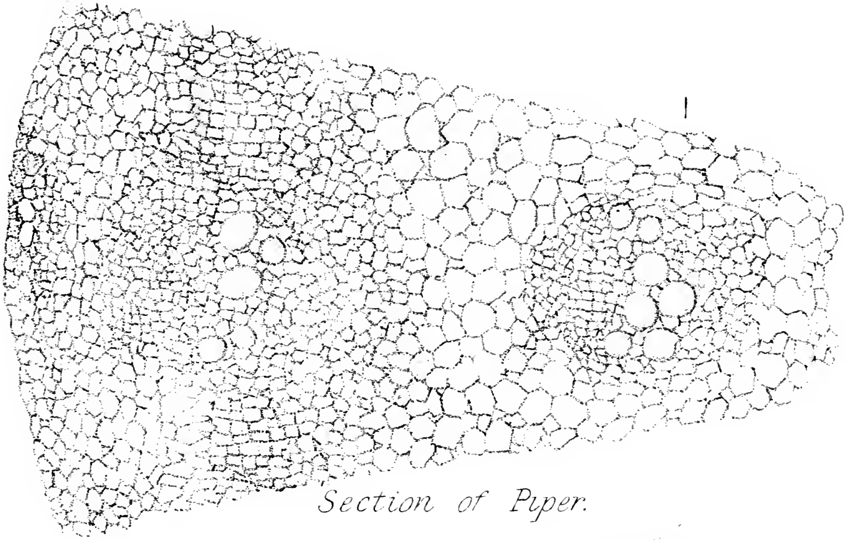
Piper.—The question raised by Mr. Hammond is of great interest. It is clear that the Piper belongs to the exogenous class of plants. The specimen so beautifully drawn by Mr. H. at first sight appears to have passed into the second year's growth. There are fibro-vascular bundles beyond the blue ring of cells which encloses the seven fibro-vascular bundles surrounding the pith or medulla. One would be apt to consider that the cells which absorb blue dye consist of woody tissue, and, therefore, that the blue continuous ring marks the first year's growth of the plant. I have spent some hours in trying to solve the problem, but with no satisfactory conclusion. In all works on structural botany the medullary rays are stated to pass from the pith to the bark. In trees these rays, as lines, are plainly seen; in humbler plants they can be discovered, but with some difficulty. In the specimen before us the medullary rays cannot be traced through the blue line of cells, which form quite a dense zone, perfectly continuous, around the central mass of parenchyma. The cells immediately outside this blue ring are of square form, and the several series of fibro-vascular tissue lie in a circle imbedded in them. It appears, also, that in time another ring of tissue would be formed, the cells of which would also take the blue dye and constitute a second unbroken zone. The absence of the medullary rays puzzles me, although it is probable that they are there, but that they have absorbed the blue dye also. I should like to have the matter cleared up by some member clever in structural botany and who is acquainted with the action of double-staining.

R. H. MOORE.



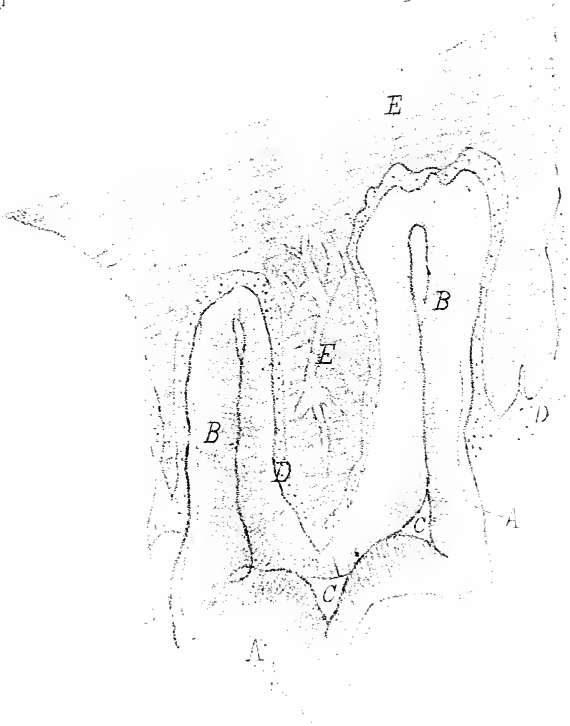
Coccus cataphractus.

Unopened Eye-lids of Kitten.



Section of Piper.

2



Molar Tooth of Mole.

Jaw of Mole (Pl. XX., Fig. 2).—In the slides which consist of half of the lower jaw of the Mole there will be seen four incisors, one canine, and six grinders, the first three of these latter being small and conical. The food of this animal consists chiefly of earthworms. For a description of the structure of teeth refer to Carpenter's work on "The Microscope and its Revelations." W. C. TAIT.

Jaw of Mole.—I enclose a sketch of one of the molars of the mole, showing what I think to be the cementum intervening between the dentine and the jaw-bone. When seen under the polariscope, this seems to show a distinct layer well defined on both sides, but besides surrounding the root of the tooth it appears to reach from one tooth to another, joining the whole set together. Is this the case, or am I mistaking a portion of the bone for cementum? F. E. ROBINSON.

EXPLANATION OF PLATES XIX. & XX.

PLATE XIX.

Fig. 1.—Coccus cataphractus, upper side.
,, 2.—Ditto, underside.
,, 3.—Egg of ditto. Drawn by Dr. C. F. George.
,, 4.—Unopened eyelids of Kitten: *a*, meibomian glands; *b*, inner surface of eyelid; *c*, bulbs of eyelashes. Drawn by A. H. Searle.

PLATE XX.

Fig. 1.—Section of Piper. Drawn by A. Hammond.
,, 2.—Section Molar Tooth of Mole, showing *a*, enamel; *b*, dentine; *c*, pulp cavities; *d*, cementum; *e*, bone. Drawn by F. R. Robinson.

Reviews.

DIE NATURLICHEN PFLANZENFAMILIEN. Von A. Engler und K. Prantl. Parts 44—48. (Leipzig: Wilhelm Engelmann. London: Williams and Norgate.)

These parts contain Euphorbraceæ, Myrsenaceæ, Primulaceæ, and Plumbaginaceæ, by F. Pax; Sapotaceæ, by A. Engler; Chætophoraceæ, Mycoideaceæ, Cylindrocapsaceæ, Oedogoniaceæ, Coleochætaceæ, Cladophoraceæ, Gomontiaceæ, Shæropleaceæ, Botrydiaceæ, Phyllosiphonaceæ, Bryopsidaceæ, Derbesiaceæ, Vaucheriaceæ, Caulerpaceæ and Codiaceæ, by N. Wille; Geraniaceæ, Oxalidaceæ, Tropæolaceæ, Linaceæ, Humiriaceæ, and Erythroxylaceæ, by K. Reiche; Compositæ, by O. Hoffmam; and Malpighiaceæ, by F. Neidenzu.

These five parts contain 147 illustrations, composed of 846 figures. The figures are beautifully engraved.

LESSONS in Structure, Life, and Growth of Plants. By Alphonso Wood, A.M., Ph.D., revised and edited by Oliver R. Willis, A.M., Ph.D. 8vo. pp. iv.—220. (New York: The American Book Co. 1890.)

The botanical student will find this work almost invaluable. The lessons are so arranged that the learner may commence either with the flower and so lead through structural botany up to the seed, or he may begin with the second part, Physiological botany, which treats of the cells and vessels that build up plants and trees. There are upwards of 500 engravings in the text.

HISTORY OF MEXICO. Vol. III. By Hubert Howe Bancroft. 8vo, pp. xv.—780. (San Francisco: The History Publishing Co.)

We have frequently had the pleasure of noticing these fine volumes by the celebrated historian. The volume before us deals with the history of Mexico between the years 1600 and 1803, and traces very minutely the course of commercial enterprise under the various government administrations, the details being given in the author's well-known interesting style, so that the reader is led on without experiencing the weariness often felt in reading dry details.

JOURNAL OF MORPHOLOGY. Edited by C. O. Whitman and Edward Phelps Allis, junior. Vol. III., No. 3. (Boston, U.S.A.: Ginn and Co. London: W. P. Collins.)

This number completes the third volume of this important work, and consists of the following papers:—The Embryology of the Earth-worm, by Edmund B. Wilson; the Morphology of the Ribs and the Fate of the Actinosts of the Median Fins in Fishes, by Dr. G. Baur; the Morphology of the Vertebrate Skull, by Dr. G. Baur; and on the position of *Chamæa* in the System by R. W. Shufeldt. This part contains 7 finely executed lithographic folding plates.

THE STORIES OF THE TREES. By Mrs. Dyson. Crown 8vo, pp. 272. (London: T. Nelson and Sons. 1890.)

Our young friends who are fortunate enough to read this book are sure to derive much pleasure and instruction from it. Some twenty-five of our native trees are described. There are several full-page plates and a number of smaller illustrations showing the leaf, flower, and fruit of most of the trees.

TIMBERS and How to Know Them. By Dr. Robert Hartig, translated by William Somerville, D.Œc., B.Sc., F.R.S.E., etc. 12mo, pp. 83. (Edinburgh: David Douglas. 1890.)

This handy little volume will help one with ease and certainty to identify timbers, and at the same time give a concise account of their composition. It contains twenty-two illustrations, which represent radial and transverse sections of wood. Many of the radial section are magnified a hundred times; the transverse are mostly magnified five times. Seventy-six species of wood are described.

THE BIRDS OF ESSEX: A Contribution to the Natural History of the County. By Miller Christy, F.L.S. 8vo, pp. viii.—302. (Chelmsford: Durrant and Co. London: Simpkin, Marshall, and Co. 1890.)

This very interesting work forms the second of the "Essex Field Club Special Memoirs" and contains Biographical Notices of the principal Essex Ornithologists; Notices of the Chief Essex Bird Collections; Migration Tables; Hawks and Hawking in Essex in the Olden Time; Wild Fowl decoys and Wild Fowling in Essex; and Catalogue of the Birds of Essex. It is a valuable contribution to our knowledge of the ornithology of the county, and contains 162 illustrations of birds drawn to scale.

Fruits and How to Use Them. By Mrs. Hester M. Poole. Crown 8vo, pp. 242. (New York: Fowler Wells and Co. 1890.)

Those who are specially fond of fruit will find in this little book an immense variety of methods in which fruit of all kinds may be served at table. We find here no less than 77 different dishes, in which the apple forms the chief ingredient.

Protoplasm and Life. By Charles T. Cox. Crown 8vo, pp. 67. (New York: N. D. C. Hodges. 1890.)

One of the "Fact and Theory Papers," and consists of two Biological essays:—I. Protoplasm and the Cell Theory; II. The Spontaneous Generation Theory and its relation to the General Theory of Evolution.

Fifty Years of Science. By Sir John Lubbock, Bart., M.F., F.R.S., D.C.L., L.L.D. Crown 8vo., pp. 111. (London: Macmillan and Co. 1890.)

This is the fifth edition of the address delivered by Sir John Lubbock to the British Association in August, 1881. Those of our readers who have not read it have a treat to look forward to. It is well worth reading.

The World-Energy: and its self-conservation. By William M. Bryant. Crown 8vo, pp. xv.—304. (Chicago, U.S.A.: S. C. Griggs and Co. 1890.)

The author tells us in his preface that this volume owes its origin to studies that began more than 20 years ago; these studies were prompted by the desire to find a satisfactory solution to the question, "What is man's place in nature?" The book is divided into 26 chapters, which treat of Matter and its Properties; Measure and the Measureless; Evolution of Life-form, etc.

Evolution, Antiquity of Man, Bacteria, Etc. By William Durham, F.R.S.E. Crown 8vo, pp. 127. (Edinburgh: A. and C. Black. 1890.) Price 2s.

This is the first of a series of books under the title of "Science in Plain Language," their object being to impart the general results of Scientific investigation in plain language without too much detail. The volume before us consists of a series of short chapters, grouped under four heads, viz.:— Natural Selection; Protoplasm; Colour; and Movement. Each article is complete in itself, and may be read without reference to any other; there is nevertheless a connection between the whole of them, and they will well repay careful reading.

Half-Hours at the Seaside; or, Recreations with Marine Objects. By Dr. J. E. Taylor. F.L.S., F.G.S., etc. Crown 8vo. pp xii.—226. (London: W. H. Allen and Co. 1890.) Price 2s. 6d.

Dr. Taylor's books are always read with interest. We have here Half-an-Hour with the Waves, Preparations, Sea-weeds, Sponges, Sea-worms, Corallines, Jelly-fish, Sea-anemones, Sea-mats and Squirts, Sea-urchins and Star-fish, Shellfish, and the Crustacea. There are 148 illustrations.

History of California. Vol. VI. By Hubert H. Bancroft. 8vo, pp. xi.—787. (San Francisco: The History Publishing Co.)

The period included in this volume is from 1848 to 1859, and comprises an account of the discovery of gold, and all the succeeding events which necessarily followed in its train; the gradual building of new towns, and arrangements for the better organisation of government; formation of committees of vigilance. An account is given of the agricultural and industrial resources of the country; steamship traffic and railroad surveys. The student of history and political economy will here find much to interest and instruct. We have previously spoken of the admirable manner in which these volumes are got up. This ranks equally well with its predecessors.

HISTORY OF OKEHAMPTON. Edited by W. H. K. Wright, F.R.Hist.Soc. 8vo, pp. xxvii.—252. (Tiverton: W. Masland. 1889.)

In the work before us we have an account of the Barony and Town of Okehampton, its antiquities and institutions, including the journals kept by Messrs. Rattenbury and Shebbeare, Gent. and Burgesses, from the 21 James I. to the Death of William III., with Notes Geological, Descriptive, and Explanatory. The work is well illustrated with maps and plates, and will be found of much interest to the antiquarian.

GREAT AFRICAN TRAVELLERS: from Bruce and Mungo Park to Livingstone and Stanley. By W. H. G. Kingston and C. R. Low, I.N., F.R.G.S. Small 4to, pp. xvi.—509. Price 7s. 6d.

This handsomely bound and well illustrated book will be read with much interest. It describes the travels of Bruce, Mungo Park, Major Denmann, and Lieut. Clapperton; Journey of the Landers to the Niger; Explorations of Dr. Barth in Central Africa; Discoveries of Capts. Burton and Speke in Central Africa; Dr. Livingstone's expeditions to Africa; the Travels of Sir Samuel and Lady Baker; Stanley's expedition in search of Livingstone; Cameron's Journey across Africa; Stanley's exploration of the Congo, and his rescue of Emin Pasha. There are 100 illustrations, many full-paged. A most attractive book.

DEERHURST, a Parish in the Vale of Gloucester. By George Butterworth, M.A. Crown 8vo., pp. xii.—252. (Tewkesbury: W. North. London: Simpkin, Marshall, and Co. 1890.) Price 2s. 6d.

A good description is here given of this interesting old parish, its priory, the Charter of Henry V., the Church, Odda's Chapel, together with an account of its houses, parish registers, Churchwardens' accounts, charitable bequests, legends, and physical features. The book is illustrated with 10 lithographic and photographic plates.

GOSSIPING GUIDE TO WALES (North Wales and Aberystwyth). pp. lxxxviii.—324.

Besides a great amount of information about all places of interest in North Wales, this travellers' guide contains Notes on Botany, by the Bishop of Wakefield and the Rev. Canon Butler, and on Geology by C. Croft. The maps show, distinctly, the chief routes and side paths, while the descriptive articles are written in a clear and easy style, giving the reader an experience of freshness and freedom, which he hopes to find in his travels through this beautiful scenery

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HANDBOOK OF GEOLOGY: for the use of Canadian Students. By Sir William Dawson, C.M.G., LL.D., F.R.S., etc. 8vo, pp. viii.—250. (Montreal: Dawson Bros. 1889.)

Although this work is intended to serve as lecture notes for teachers of Geology in the Dominion of Canada, it, however, may be read with profit by students living in other parts of the world. The first part relates to the general principles of science. The second gives an outline of Geological Chronology, illustrated by Canadian rock-formations and fossils. The third part gives details as to the Physical Geography and Geology of Canada. There are upwards of 170 illustrations.

Away from Ice and Snow: or to Manilla in Winter. By Andrew D. Barrie, M.D., C.M. Crown 4to, pp. 70. (Dumfries: Anderson and Son.) Price 1s.

A nice account of a very pleasant trip to the Philippine Islands, which was commenced on the 21st Nov., 1888, and Manilla reached, after calling at many interesting places, on 23rd Jan, 1889.

Weather Forecasting for the British Islands. By Capt. Henry Toynbee, F.R.A.S., F.R.G.S., F.R.Met.S., etc. (London: Edward Stanford. 1890.)

The object of this little work is to show what a single observer can do towards forecasting wind and weather at his station, supposing him to have a barometer, means for observing, roughly, the direction and force of the wind, and powers to recognise cirrus clouds and the direction from which they are coming.

Larva Collecting and Breeding. By the Rev. Seymour St. John, B.A. pp. 164. (London: W. Wesley and Son. 1890.)

This handbook, to the Larvæ of the British Macro-Lepidoptera and their food plants both in nature and in confinement, is convenient to the pocket, and will be found a helpful companion during a collecting expedition. It is divided into two parts, and gives first a list of the larvæ, with the scientific and common names of all the plants on which they are found. Second a list of plants, with names of the larvæ which commonly feed on them.

Wild Nature Won by Kindness. By Mrs. Brightwen. Crown 8vo, pp. 220. (London: T. Fisher Unwin. 1890.)

In this delightful book Mrs. Brightwen tells the life-histories of some of her pets, and an account of much she has observed respecting them. The book is pleasantly written and nicely illustrated, and we hope it may lead those of our young friends who read it to regard every created thing, great or small, attractive or otherwise, as an object well worth careful study.

Gems and Precious Stones of North America. By George Frederick Kunz. Imperial 8vo. 11 in. by 5½ in., pp. vi.—336. (New York: Scientific Publishing Co. 1890.) Price $10 or £2 2s.

This fine work gives a popular description of the occurrence, value, history, and archæology of gems and precious stones, and the collections in which they exist; there is also a chapter on pearls, and remarkable foreign gems owned in the United States. It is illustrated with 8 coloured plates, 16 full-page illustrations, and 20 illustrations in the text. We believe Mr. Kunz is acknowledged to be the greatest authority in the United States on the subject of which he treats. To the collector, whether in England or America, this work will be invaluable.

The History and Description of the Collie or Sheep Dog in his British Varieties. By Rawdon Lee. 8vo, pp. vii.—157. (London: H. Cox, "The Field" Office. 1890.) Price 3s. 6d.

In the work before us Mr. Lee traces the progress from the fold and mountain to the drawing room and parlour of this interesting species of dog, whose value has been often assessed at as high a figure as £100. Frequent mention is made of the varied duties he is called upon and expected to fulfil. The work is well illustrated with several plates and vignette illustrations. The book will be read with interest by all dog-lovers.

MANUAL OF COLOURS. By Henry Seward, F.C.S. Crown 8vo, pp. 67. (London: Geo. Rowney and Co.) Price 1s.

This useful little handbook gives an account of the Pigments used by the ancients and old masters; describes the processes employed in the manufacture of pigments, with experiments on the action of Light on Water-colours, etc. etc. There are 3 coloured plates showing 72 colours, with their names and the shades of colour to be obtained from them.

UNTRODDEN GROUND IN ASTRONOMY AND GEOLOGY. By Major-General A. W. Drayson, F.R.A.S. 8vo, pp. xii.—305. (London: Kegan Paul, Trench, Trubner, and Co. 1890.)

In this work full details are given of the *second* rotation of the earth, and the important facts that are revealed by a knowledge thereof. This movement, the Author tells us, fully explains the cause of the precession of the equinoctial points, of the change in the polar distance and right ascension of the stars, of the decrease in the obliquity of ecliptic, and also gives the date and duration of the last Glacial Period.

A SYSTEM OF PRACTICAL and Scientific Physiognomy. By Mary Olmsted Stanton. 2 vols., royal 8vo, pp. xxxvi.—1222. (Philadelphia and London: F. A. Davis. 1890.) Price £2 2s.

This is a large and exhaustive work on a subject which has a great attraction for a certain class of minds. If it be true that every face exhibits either a history or a prophecy, this book may help the observer to discipher it to a certain extent; but those who believe that the proper study of mankind is man, and who desire to obey the ancient advice, "Know thyself," will desire some more trustworthy guide than Physiognomy. The Authoress gives the results of considerable research, and of much discriminating observation, and has produced a work well worthy of perusal. There are 380 illustrations, mostly portraits of European and American celebrities.

ADVANCED PHYSIOGRAPHY (Physiographic Astronomy). By John Mills. Crown 8vo, pp. xii.—292. (London: Chapman & Hall. 1890.)

Students will here find an account of all the subject matter in the Science and Art Department's advanced syllabus of Physiography. It is a complete and strictly scientific introduction to Astronomical Science. The illustrations are good and the examples very useful.

NUMBERS UNIVERSALIZED: An Advanced Algebra. By David M. Sensenig, M.S. In two parts. Crown 8vo, pp. ix.—492. (New York: The American Book Company. 1890.)

This treatise embraces all the Algebraic subjects usually taught in Schools and Colleges, and is issued in two parts for the convenience of pupils more or less advanced. Much care is shown in the logical arrangement of the definitions, all of which are expressed in simple, concise language. Due prominence has been given to the working of factors and quadratic equations, while the series of exercises are well graduated, and will enable the student to put into practice the knowledge gained from the study of the examples. The chapters on proportion, geometrical progression, annuities, and logarithms, are particularly clear and well considered.

TWELVE YEARS' QUEEN'S SCHOLARSHIP QUESTIONS, 1878—89, with Answers to Arithmetic, Algebra, and Mensuration. 12mo, pp. 314. (London: Moffat and Paige. 1890.) Price 3/6.

These Questions will be of considerable help to students training for Examinations, and to others who desire papers to test their progress in the acquirement of languages, etc.

MOFFATT'S NEW GEOGRAPHY. Edited by Thomas Page, and revised by Rev. E. Hammonds, M.A. Crown 8vo, pp. 428. (London: Moffatt and Paige. 1890.) Price 4s. 6d.

This Manual treats of Astronomical, Physical, Commercial, and Political Geography. Pupils preparing for Examination will find it a handy text-book and work of reference. The information appears to be well brought up to date, a separate section being added dealing with African Exploration.

MOFFATT'S EDITION OF SHAKESPEARE'S Richard II., with Introduction and Notes, arranged and classified. Crown 8vo, pp. 159. (London: Moffatt and Paige. 1890.)

Much information is contained in this volume besides the text and the notes thereon, viz.:—Short accounts of the Historical Personage of the Drama, Sketches of the Principal Characters, Notable Passages for committing to Memory, Examples of Analysis of Sentences, Paraphrasing, and Typical Questions selected from Examinations.

THE EARTH AND THE SOLAR SYSTEM. By Thomas Page. 10th Edition. Crown 8vo, pp. 63. (London: Moffatt and Paige. 1890.) Price 1s.

This treatise is specially designed for pupil teachers of the 2nd, 3rd, and 4th years, but we believe it will be found serviceable as a class book, and more particularly for Home-work. There are Chapters on Latitude and Longitude, Tides and Currents, Winds, and Climates.

THE LIFE OF ST. PATRICK. By William B. Morris. Crown 8vo, pp. xviii.—303. (London and New York: Burns and Oats. Dublin: M. H. Gill and Son. 1890.)

Those interested in the life of the Apostle of Ireland will find much here to interest them. The book is well written, and contains an account of the sources from whence the Saint's history has been derived.

ESSAYS OF AN AMERICANIST. By Daniel G. Brinton, A.M., M.D. 8vo, pp. 489. (Philadelphia, U.S.A.: Porter and Coates.) Price $3.

A valuable contribution to the study of the native American tribes, their history, antiquities, religion, and literature, by one of the best known scholars in this branch of Science. The work is divided into four sections, I. Ethnologic and Archæologic; II. Mythology and Folk-Lori; III. Graphic Systems and Literature; IV. Linguistic.

THE LIFE of the Right Honourable William Ewart Gladstone. By George Barnett Smith. Crown 8vo, pp. viii.—604. (London: Ward, Lock, and Co. 1890.)

This work has now reached its twelfth edition; in it the author lays before the reader the story of Mr. Gladstone's Life, and his relations to the great movements of his time, through the medium of his writings and speeches. A good portrait forms the frontispiece to this volume.

ANNUAL OF THE UNIVERSAL MEDICAL SCIENCES. Edited by Charles E. Sajons, M.D., and seventy associate editors. 5 vols, 8vo, pp. about 2,600. (London and Philadelphia: F. A. Davis. 1890.)

In this, the third annual issue of this important work, several new departments have been added, and others have undergone modifications which will prove of value to the reader. A considerable improvement has also been effected in the very voluminous index, which fills no fewer than 104 pages. A separate section is devoted to each subject, and these number in the five volumes seventy-three sections. The volumes are handsomely bound, and contain many plain and coloured plates in addition to wood engravings.

SICKNESS OR HEALTH? or the Danger of Trifling Ailments. By M.D., C.M., a family doctor. Crown 8vo, pp. 286. (London: Jarrold and Sons.)

In this work good advice in plain language is given with respect to many of our every-day ailments, but the author states very emphatically that no kind of chronic ailment can be removed or remedied without striking deeply at its root and removing the cause, and that the abjuring of all bad habits of living and obedience to the golden rules of health will cure about two-thirds of the chronic ills that flesh in this weary work-a-day world is heir to.

THE OLD DOCUMENTS and the New Bible. By J. Paterson Smyth, LL.B., B.D. Crown 8vo, pp. xiv.—216.

HOW WE GOT OUR BIBLE. By the same Author. pp. iv. —127. (London: S. Bagster and Sons. 1890.)

These two books are written in very clear language and in the author's own fascinating style. The account of the Old Bibles gives a good understanding of the methods of Biblical criticism at a time when an increasing thirst for knowledge calls for satisfaction at the hands of those who are well fitted to supply the want. A new edition of the smaller volume completing the thirty-first thousand shows how this little work has been appreciated.

SANITY AND INSANITY. By Charles Mercier, M.B. Crown 8vo, pp. xix.—395. (London: Walter Scott. 1890.)

An endeavour is here made to account for the phenomena of insanity. The book is divided into fifteen chapters and treats of:—The Nervous System, The Mind, What Insanity is, The Causes and the Forms of Insanity, etc.; and is illustrated with twenty illustrations.

FROM THE FARM TO THE BATTLE-FIELD. By Mrs. Clara Walbey. Crown 8vo, pp. vii.—182. (London: Simpkin, Marshall, and Co. Hertford: S. Austin and Sons. 1890.) Price 2s. 6d.

Three separate stories are comprised in this book. The stories are interesting, but totally unconnected. We consider the title misleading.

HYPNOTISM. By Albert Moll. Crown 8vo, pp. xii.—410. (London: Walter Scott. 1890.) Price 3s. 6d.

Great curiosity has of late been aroused by the accounts which have from time to time appeared with regard to the effects produced on persons under hypnosis, and to those who wish for a description of the methods employed and a full discussion upon the scientific and practical aspects of hynotism, we recommend these pages for perusal.

PRACTICAL FLASH-LIGHT PHOTOGRAPHY. By Robert Kingsley. 4to. (London: Marion and Co.)

A very handsomely got-up volume with four whole-plate photographs; it is a treatise on Magnetism, Flash-Light Photography, and gives Mr. Kingsley's practical experience. We feel assured that by simply following his instructions photographers and amateurs may arrive at great excellence in Flash-light work.

This system opens a large field to the photographer, as by it he is enabled to take photographs of meetings, balls, or, indeed, of any indoor entertainment. The price of the book is 4s.

THE INTERNATIONAL ANNUAL of Anthony's Photographic Bulletin. Edited by W. Jerome Harrison and A. H. Elliott. Crown 8vo, pp. xix.—489. (London: Iliffe and Son. New York: E. and H. T. Anthony and Co. 1890.)

The third issue of this important annual is before us. It contains upwards of two hundred articles on every subject relating to photography, contributed by nearly as many writers, many of them of world-wide celebrity in their profession. The plates, which are very numerous, are excellent—each in its own special method of production.

TRAITE PRATIQUE DE PHOTOGRAPHIE: Appliquee au dessen industriel. Par Amédée Masselin. Crown 8vo, pp. 134. (Paris: Gauthier-Villars et Fils. 1890.)

Without entering into the chemical and optical theories involved, this treatise gives precise instructions in photography, sufficient for architects, engineers, and others to acquire a practical knowledge of the art.

LA PHOTOGRAPHIE JUDICIAIRE: Avec un appendice sur la Classification et l'identification anthropometriques. Par Alphonse Bertillon. (Paris: Gauthier-Villars et Fils. 1890.)

A treatise on forensic photography, showing the precautions which should be taken in photographing criminals to insure identification. Of course, no retouching is allowed, as every freckle or other mark must be carefully preserved. There is an interesting chapter on anthropometry.

LA PHOTOGRAPHIE SANS MAITRE. Par Eug. Dumoulin. (Paris: Gauthier-Villars et Fils. 1890.)

This introduction to photography is especially addressed to beginners. The author recommends the ferrous-oxalate developer for time exposures and hydroquinone for instantaneous work. A formula is given for eikonogen, and directions are given for making a pinhole camera.

MANUEL D'HELIOGRAVURE et de Photogravure en Relief. Par M. G. Bonnet. (Paris: Gauthier-Villars et Fils. 1890.)

A description of two modes of photo-mechanical printing. In one process a copper plate is covered with bichromated gelatine, exposed to the light under a negative and then treated with perchloride of iron, which eats away the surface of the copper under those parts of the gelatine film not hardened by exposure to the light. In the other process the prints are taken direct from the gelatine film.

LA PHOTOGRAPHIE AERIENNE. Par cerf-volant par Arthur Babut. pp. 74. (Paris: Gauthier-Villars et Fils. 1890.)

Photography, by means of a kite, is a perfectly practical proceeding for any photographer understanding instantaneous photographing. M. Babut minutely describes the different apparatus used; he shows the means of obtaining considerable heights, and of raising even without wind the camera by means of a kite, and of knowing exactly the vertical height at which the operation will be effected. A charming photograph illustrates the work, and shows how successful the style of photography may be made in a campaign or voyage of discovery.

A Casket of Photographic Gems, collected by W. Ingles Rogers. Crown 8vo, pp. xvi.—126. (London: Piper and Carter. 1890.) Price 1s.

A collection of 500 dodges, receipts, experiments, etc., in connection with the art of photography and its branches, many of which we should judge to be exceedingly useful. They relate to work in the field, in the dark-room, and in the printing-room, lantern dodges, etc.

Practical Photo-Micrography by the Latest Methods. By Andrew Pringle, F.R.M.S. 8vo, pp. ix.—183. (New York: Scoville and Adams Co. 1890.)

This is a very thorough treatise on the art of photo-micrography. The author has directed his investigations, in a great measure, to two great and novel features of the science, viz.—Apochromatic Objectives and Colour-correct Plates. He has written deliberately and confessedly for the Natural and Medical Sciences rather than for those who use the microscope simply as a pastime. The book contains six fine photo-micrographic plates, besides upwards of 40 woodcut illustrations.

About Photography and Photographers. By H. Baden Pritchard, F.C.S. Crown 8vo, pp. iv.—220. (London: Piper and Carter.) Price 2s.

A series of essays for the studio and study; to which are added Continental Rambles with a Camera. A great number of matters interesting to the photographer are here treated of.

The Photographic Instructor. Edited by W. J. Lincoln Adams. With an Appendix by Prof. Charles Ehrmann. 8vo, pp. 215. (New York: Scoville and Adams Co. 1890.)

A second edition of this famous work contains a comprehensive series of Practical Lessons issued to the students of the Chautauqua School of Photography. The appendix describes the nature and use of the various chemicals and substances employed in photographic practice. The book is well illustrated.

The Encyclopædia of Photography. By Walter B. Woodbury. Part I. Price 6d. (London: Iliffe and Co.)

This will prove a valuable work for the photographer. It will contain over 2,000 references and be illustrated with 200 explanatory sketches and diagrams.

Photogravure. By W. T. Wilkinson. Crown 8vo, pp. 40. (London: Iliffe and Son. 1890.) Price 1s. 6d.

The author tells us that process photogravure is simple, very interesting, and not at all tedious, and up to the last stage of printing from the plate requires little apparatus or material beyond that found in most amateur's photographic dark-rooms. The process is fully described in this little book.

The Evolution of Photography. By John Werge. Crown 8vo, pp. viii.—312. (London: Piper and Carter. 1890.) Price 5s.

A comprehensive and pleasantly written summary of all that has been done in the past in relation to photography, giving a chronological record of the various processes as they have appeared and effected radical changes in the practice of the art, together with many personal reminiscences, extending over forty years. There are four photographic plates, giving portraits and other examples of photography in the first, second, third, and fourth period of the art.

Sir John Franklin, the discovery of his fate, after forty years' silence, now made public. Crown 8vo, pp. xvi.—320. (London: Bemrose and Co.)

We have but little to add to our former notice of this book; the whole matter is beyond our comprehension. The present volume contains a supplement in which is given certain letters, written by Lady Franklin and Miss Cracroft. The style of writing adopted by the reverend author partakes too much of the character of the "showman," and to our mind is not so convincing as it would have been if written in a less positive style. We fail to see the necessity for the forty years' silence. Forty years ago the facts could have been easily proved; now it is only aged people who can possibly have any positive knowledge of these events.

Mr. Elliot Stock sends us—

Berkshire Notes and Queries: a Quarterly Journal devoted to the Family History, Antiquities, and Topography of the Royal County. Edited by F. Tudor Sherwood. Price 1s. 6d. Annual Subscription, including postage, 5s.

The Field Club. A Magazine of General Natural History for Scientific and Unscientific Readers. Edited by Rev. Theodore Wood. Price 3d. Monthly.

The Antiquary. A Magazine devoted to the study of the past. Price 1s. monthly. A new volume commenced with the July number.

The Naturalists' Publishing Co., Birmingham, have sent us the following publications:—

The Naturalists' Calendar and Weather Guide. Price 6d. Gives each month a list of Plants, Insects, Fishes and Reptiles, Birds, and Mammals in their probable order of occurrence. Plants and Animals as Weather Guides. Forecasts of the Seasons and Plants as tests of the purity of the air.

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The Naturalists' Gazette. No. 20, Monthly, 1d.

By Sea and Shore. A Magazine of Local Natural History. Edited by R. Augustine Clarke, M.A., at Rossall School. Frice 4d. Monthly.

The Naturalists' Record: or Journal of Science and Art, and Amateur Photographers' Own Magazine. Price 2d. Monthly. (London Publishers: E. W. Allen and Co.)

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