

WONDERS OF THE MICROSCOPE

A letter of Galileo to Federico Cesi, written from Florence, and dated September 23, 1624, runs as follows:—"I send your Excellency an 'occhialino' by which to see close smallest things, which I hope will give you no small pleasure and entertainment, as it does me. I have been long in sending it, because I could not perfect it before, having experienced some difficulty in finding the way of cutting the glasses perfectly. The object must be placed on a movable circle which is at the base, and moved to see it all, for that which one sees at one look is but a small part. And because the distance between the lens and the object must be most exact in looking at objects which have relief one must be able to move the glass nearer or further, according as one is looking at this or that part; therefore, the little tube is made movable on its stand or guide, as we may wish to call it. It must also be used in very bright, clear weather, or even in the sun itself, remembering that the object must be well illuminated. I have contemplated very many animals with infinite admiration, amongst which the flea is the most horrible, the gnat and the moth the most beautiful, and it was with great satisfaction I have seen flies and other little animals manage to walk sticking to the glass, and even feet upwards. But your Excellency will have the opportunity of observing thousands and thousands of other details of the most curious kind, of which I beg you to give me account. In fact, one may contemplate endlessly the greatness of Nature, and how subtly she works, and with what unspeakable diligence."

This occhialino of its inventor, or the microscope as we nowadays call it, is an instrument that has contributed a great deal to the pleasure as well as to the profit of mankind (says *St. Xavier's Magazine*). We can well imagine the Tuscan philosopher glowing with delight as, bending over his tube, he sees a fly as big as a hen, nor shall we blame him if he proudly reports the same to all his friends and patrons. Let those who wish scan the heavens and mark the craters in the moon and the dark and bright spots in the sun. The revelations of the microscope are as interesting and more useful, as they relate to objects not millions of miles away, but directly under our feet, objects that are constantly benefiting or harming us. Yet, so very obscure are they, that but for the microscope we should be

Totally Ignorant of Their Very Existence.

We may well call the microscope an alchemy that turns dust into gold. What could be more nauseating than a pool of stagnant water! To the microscopist, however, it is more valuable than the richest mine of Kimberley. He takes a drop from it, mounts it on his slide, and lo! that simple drop of stagnant water is immediately converted into a little ocean teeming with plant and animal life. There may be seen the *Proteus amoeba*, the simplest of animals, now looking like a drop of jelly, now throwing out arm-like projections which flow round some minute organism that the animal has destined for its prey. The sea does not engulf a rock more surely, though slowly, than this animal does its prey.

While the movement of the sluggish amoeba is hardly perceptible, active little slipper-animacules, rotifers, and crustaceans of various forms are darting about with great rapidity, now coming within the field of vision, now disappearing beyond it just as we are trying to have a good look at them. If we have been fortunate enough to get on our slide a rootlet of duck-weeds, we may have the pleasure of seeing attached to it a whole colony of bell-animacules, looking not unlike a cluster of fox-gloves, and exciting great interest by their contractions and expansions and other exhibitions of life and activity.

Larger animals need no microscope to proclaim their existence. But still a microscope is required for the study of the structure of their different organs, and a most interesting and useful study it is. For instance,

to know that the blood of an earthworm or some such invertebrate, though to all appearances quite like human blood, differs from it in structure, its plasma being red and corpuscles white, while the contrary is the case with the blood of vertebrates. If, further, we separate the coloring matter from the red corpuscles and then cause it to be crystallised, we shall see that the blood-crystals of man and most animals are rhombic prisms, but those of the guinea-pig tetrahedra, and those of the squirrel hexagonal plates. Structures of nerve and muscle fibre, bone and cartilage, and other tissues that go to form the complex animal body as depicted by the microscope give us a better idea of the infinite skill of the Creator than we can possibly have from contemplating the enormous orbs that nightly roll across the sky. No class in

The Whole Animal Kingdom

affords to the microscopist such a wonderful variety of interesting objects, and such facilities for obtaining an almost endless succession of novelties as that of insects. The vast number of species included in this class enables us to have a large collection with little trouble, and their preparation for the microscope, too, generally entails little labor. The common house-fly, perhaps a little too common for our comfort, will serve as an example. Its eye may be easily mounted as a sample of a compound eye. The microscope reveals to us the astonishing fact, entirely beyond the reach of direct observation, that the organ of vision of a fly is not simple like ours, but consists of something like 4000 tiny eyes closely packed side by side, each perfect in itself. The wings, with their canals or nervures, and the proboscis are also worth while peeping at. The 'tracheae,' or canals through which the insect breathes, show under the microscope as thin-walled tubes, stiffened and kept open by an inner lining of a very fine spiral and elastic thread, so as to ensure the free passage of air from one end of the tube to the other. But what excites our greatest admiration is the peculiar formation of the foot, which enables the fly to walk over smooth surfaces directly in opposition to the laws of gravity. The limb is provided with two flat paddle-like appendages called 'pulvilli,' which are covered all over with fine hair, each hair having a disc at its extremity. These discs enable the insect to walk over smooth surfaces, either by secreting some adhesive liquid or by using them as suckers so that the insect is held fast to the substance merely by the external pressure of the air.

Butterflies, too, are easily obtained. The shiny powder that comes off on our fingers when we touch the wings is nothing but scales covering the organs of flight. Our interest is also excited by the peculiar build of the long snout by means of which these fair creatures extract nectar from flowers. The microscope shows that it is not a simple tube, as it appears to the naked eye, but is made up of two half-tubes, placed side by side and firmly interlocking with each other by means of hair-like bristles, and thus forming one tubular sucker.

Few only have such universal sympathy as to be interested in the question whether the planet Mars is inhabited or not. But the bite of the mosquito disturbs every man's business and bosom; and it is good to know what sort of weapons our enemy is provided with. If we examine the mouth parts of a mosquito we shall find that Nature has supplied it with a hard stilet having saw-like tips and a hollow tubuliform proboscis within which the stilet rests. When the insect has chosen a good prey, the stilet darts out and inflicts a wound, while the proboscis sucks up the blood that issues forth.

Plants and Minerals

afford no less interesting matter of study for the microscopist. What with leaves, tender shoots, roots, flowers, and fruit, a single plant will supply us with ample material for our observation. We can have cross sections and longitudinal sections, and the task of

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