EVENINGS

AT THE MICROSCOPE.

CHAPTER I.

HAIRS, FEATHERS, AND SCALES.

Not many years ago an eminent microscopist received a communication inquiring whether, if a minute portion of dried skin were submitted to him, he could determine it to be *human* skin or not. He replied, that he thought he could. Accordingly a very minute fragment was forwarded to him, somewhat resembling what might be torn from the surface of an old trunk, with all the hair rubbed off.

The professor brought his microscope to bear upon it, and presently found some fine hairs scattered over the surface; after carefully examining which, he pronounced with confidence that they were *human* hairs, and such as grew on the naked parts of the body; and still further, that the person who had owned them was of a fair complexion.

This was a very interesting decision, because the fragment of skin was taken from the door of an old

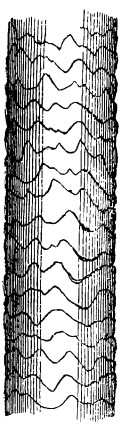
church in Yorkshire;* in the vicinity of which a tradition is preserved, that about a thousand years ago a Danish robber had violated this church, and having been taken, was condemned to be flayed, and his skin nailed to the church-door, as a terror to evil-doers. The action of the weather and other causes had long ago removed all traces of the stretched and dried skin, except that from under the edges of the broad-headed nails, with which the door was studded, fragments still peeped out. It was one of these atoms, obtained by drawing one of the old nails, that was subjected to microscopical scrutiny; and it was interesting to find that the wonder-showing tube could confirm the tradition with the utmost certainty; not only in the general fact, that it was really the skin of man, but in the special one of the race to which that man belonged, viz. one with fair complexion and light hair, such as the Danes are well known to possess.

It is evident from this anecdote that the human hair presents characters so indelible that centuries of exposure have not availed to obliterate them, and which readily distinguish it from the hair of any other creature. Let us then begin our evening's entertainment by an examination of a human hair, and a comparison of it with that which belongs to various animals.

Here, then, is a hair from my own head. I cut off

* I am writing from memory, having no means of referring to the original record, which will be found in the first (or second) volume of the "Transactions of the Microscopical Society" of London. The general facts, however, may be depended on.

about half an inch of its length, and, laying it between two plates of glass, put it upon the stage of the microscope. I now apply a power of 600 diameters; that is, the apparent increase of size is the same as if six hundred of these hairs were placed side by side. Now, with this eye-piece micrometer, we will first of all measure its diameter.



HUMAN HAIR.

You see, crossing the bright circular field of view, a semi-pellucid cylindrical object; that is the hair. You see also a number of fine lines drawn parallel to each other, exactly like those on an ivory rule or scale, with every fifth line longer than the rest, and every tenth longer still. This is the micrometer, or scale by which we measure objects; and the difference in the length of the lines, you will readily guess, is merely a device to facilitate the counting of them. By moving the stage up or down, or to either side, we easily get the hair to be exactly in the centre of the field; and now, by adjusting the eye-piece, we make the scale to lie directly across the hair, at right angles with its length. Thus we see that its diameter covers just thirty of the fine lines; and as, with this magnifying power, each line represents 1-10,000th of an inch, the hair is 30-10,000ths, = $\frac{1}{333}$rd of an inch, in diameter.

In all branches of natural history, but perhaps pre-eminently in microscopic natural history,—owing to its greater liability to error from illusory appearances,—we gain much information on any given structure by

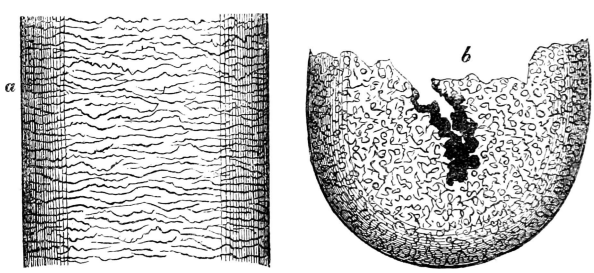
comparing it with parallel or analogous structures in other forms. Thus we shall find that our understanding of the structure of this hair will be much increased when we have seen, under the same magnifying power, specimens of the hair of other animals. In order, however, to explain it, I must anticipate those observations.

What we see, then, is a perfectly translucent cylinder, having a light brown tinge, and marked with a great number of delicate lines, having a general transverse direction, but very irregularly sinuous in their individual courses. These lines we perceive to be on the surface; because, if we slowly turn the adjustment-screw, the lines grow dim on the central part of the cylinder, while those parts that lie near the edges (speaking according to the optical appearance) come into distinctness. Presently the edges of the cylinder become sharply defined, and are seen to be cut into exceedingly shallow saw-like teeth, about as far apart as the lines; these, however, are so slight that they can be seen only by very delicate adjustment. We go on turning the screw, and presently another series of transverse lines, having the same characters as the former, but differing from them individually, come into view, at the sides first, and presently in the middle, and then, as we still turn, become dim, and the whole is confused. In fact, our eye has travelled, in this process, from the nearer surface of the hair, right through its transparent substance, to the farther surface; and we have seen that it is surrounded by these sinuous lines, which the edges—or those portions of the hair which would be the edges, if it were

split through the middle (for, optically, this is the same thing)—show to be successive coats of the surface, suddenly terminated. If we suppose a cylinder to be formed of very thin paper, rolled up, and then, with a turning-lathe, this cylinder to be tapered into a very lengthened cone, the whole would be surrounded by lines marking the cut-through edges of the successive layers of paper; and, owing to the thickness of the paper not being mathematically equal in every part, these edges would be sinuous; exactly as we see in these lines upon the hair. The effect and the cause are the same in the two cases.

A hair is closely analogous to the stem of a plant; inasmuch as it grows from a root, by continual additions of cells to the lower parts, which, as they lengthen, push forward the ever-lengthening tip. Indeed, in some of the hairs which we shall presently look at, there is the most curious resemblance to the stem of a palm, with the projections produced by the successive growth and sloughing of leaf-bases around the central cylinder. Internally, too, the resemblance is remarkable; for, if we split a human hair, and especially if we macerate it in weak muriatic acid, we shall find it composed of (1) a thin but dense kind of bark, forming the successive overlapping scales just described; (2) a fibrous substance, extending from the bulb to the point of the hair. By soaking the hair in hot sulphuric acid, this fibrous substance resolves itself into an immense number of very long cells, pointed at each end, and squeezed by mutual pressure into various angular forms. "A human

hair, of one-tenth of a line in thickness,* has about 250 fibrils in its mere diameter, and about 50,000 in its entire calibre: so that these ultimate fibrils are finer than those of almost any other known tissue, from the great elongation and narrowing of their constituent cells as they are drawn out into the shaft of the hair during growth; and hence the expanded bulb of the hair, where the cells are yet spherical and soft."† (3) Running through the very centre of the fibrous portion may be sometimes discerned a dark slender line, which is a sort of pith (*medulla*), composed of minute roundish cells, filled with air, and arranged in two or three rows.



HOG'S BRISTLE.

The bristles of the Hog bear much resemblance to the human hair. On this slide is one, which you perceive is just thrice as thick as the hair that we have been examining, or $\frac{1}{100}$th of an inch in diameter. The sinuous lines across the surface are proportionally

* This is nearly thrice as great as the diameter I had given above, which was the result of several careful admeasurements of different hairs, taken from childhood and adult age.

† Grant, Outl. Comp. Anat. 647.

far finer and closer together, and no saw-teeth are visible at the edge, the most delicate adjustment showing only a minute undulation in the outline; that is to say, the overlapping scales are far thinner, and therefore their terminations are nearer together, in the hair of the Swine than in that of Man. I will now show you a transverse section of a similar bristle, which I will obtain thus: I take this old brush, and with a razor cut off one of the bundles of bristles, close to the wood; then I take off as thin a shaving as I can cut, wood, bristles, and all: I repeat the same operation two or three times. Now, picking out the shavings of wood, I take up a few of the dust-like atoms with the point of my penknife, and scatter them on this plate (or slide) of glass, and these I cover with another plate of thin glass; for this dust is composed of thin transverse slices of the bristles, and as I scatter them, some will fall upon their cut ends, so that we shall look through them endwise.

Here is one, very suitable for examination,—since it is not a whole section, the razor having passed somewhat obliquely across it, coming out beyond the middle, where it thins away to an edge. The outline is not circular, but elliptical; that is, the hair is not round, but flattened. There is no separable *cortex*, or bark, and the whole substance appears made up of excessively fine fibres, of which we see the ends cut across. A rough dark line occupies the middle of the slice, in the plane of the greater diameter; but at the edge of the slice we are able to see that this is not a solid core, as has been sometimes supposed, but a cavity passing up through

the hair. It is surrounded by a layer of medullary cells, which appear black, because they are filled with air.

The finer hairs of the Horse and the Ass, such as those selected from the cheeks, have the sinuous edges of the plates about as close as in human hair. But they are distinguished at once by the conspicuousness of the medullary portion, which is thick, and quite opaque, and is broken up (especially towards each extremity of the hair) into separate longitudinal irregular masses.

The fine wool of the Sheep is clothed with imbrications, proportionally much fewer than those of human hair, while the diameter is also much less. Thus these examples, selected from fine flannel and from coarse worsted, vary in diameter from $\frac{1}{2000}$th to $\frac{1}{700}$th of an inch; and there are, upon an average, about two imbrications in a space equal to the diameter. No colour is perceptible in these specimens; they are as transparent and colourless as glass. The imbricated plates project here considerably more than in either of the examples we before examined; the "teeth," however, form an obtuse angle.

FIBRE OF SHEEP'S WOOL.

We shall presently see the importance of this imbricate structure; but we will first look at a few more examples, in which we shall find it still more strongly developed, in conjunction with some other peculiarities. All the hairs that we have looked at are what I have called fibrous

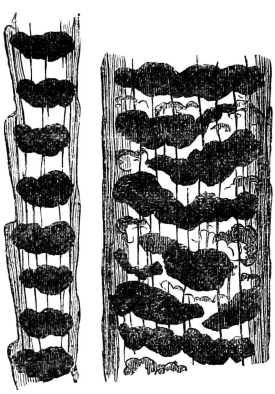
in their interior texture, but those of many animals are more distinctly cellular.

Thus, in these specimens, plucked from the fur of the Cat that lies coiled up on the hearthrug, we see, first, that the imbrications are short, being about equal to the diameter in length, but are very strongly marked; though, like those of the Sheep's wool, obtuse. Hence, the contour is extremely like that of the stipe of an old rough palm-tree. There is a distinct bark (*cortex*), which is thick, and marked with longitudinal lines, which add to the resemblance just alluded to. The interior is clear, marked off at pretty regular intervals by the broad flattened medullary cells, in single series, each cell occupying, for the most part, the whole breadth of the interior. These cells are transparent and apparently empty; but their walls appear opaque and almost black,—an optical illusion, dependent on the absorption of the light by their surfaces at certain angles with the eye of the beholder. The fibrous portion is here almost displaced by the great development of the medullary cells.

HAIR OF CAT.

In the larger hairs of the Mole, which we will now look at, the bark is very thin; and though the surface is marked with sinuous lines, these do not project into teeth. The pith here again forms the greater portion of the hair, the cells of which it is composed being placed in single series, which, for the most part, extend all across the body of the hair, though they are

somewhat irregular both in size and shape. They are rather flattened, and appear perfectly black (that is, opaque) by transmitted light, their surfaces absorbing all the rays of light. The small hairs of the same animal, however, are very different in form: they are flattened, so as to appear twice as broad in one aspect as in another at right angles to it; and, what is curious, the scales of the bark project into strongly-marked imbrications on one side, and are scarcely perceptible on the other. Here, as in the larger hairs, there is a single row of oval transverse cells, perfectly opaque.



HAIRS OF MOLE.

The hair of many of the smaller Mammalia shows considerable diversity of form, according to the part which we select for observation. Thus, if we take a long hair out of this Sable tippet, and examine it near the base, we see that it is very slender, transparent, and colourless, covered with strongly-marked imbrications, which are not obtuse teeth, but long, pointed, overlapping scales, about ten of which complete a whorl. The fibrous portion is moderately thick; inclosing a wide pith of roundish cells, set in two rows, that allow the rays of light to be transmitted through their central parts.

As we trace the hair upwards, by moving the stage of the microscope, by and by it swells and rapidly