The "Gastric Mill" of the Crayfish

FOR demonstrating the structure and action of the elaborate gizzard of the crayfish, which I have found to be usually regarded as a hopeless puzzle, I have constructed, in Prof. Lankester's laboratory at University College, at his suggestion and for the use of his class of practical zoology, a little model, the simplicity of which enables any student to construct one for himself, and thus thoroughly to apprehend the mechanical significance of the apparatus found in the crustacean.

A description of it will be useful to some of your readers.

Out of a sheet of good cardboard cut a piece having the shape represented in Fig. 1. Along the lines marked *ab*, *cd*, *ef*, *hi*, *mn*, draw a penknife so as to slightly cut into the cardboard, and on the opposite face of the cardboard make similar cuts along the lines *gh*, *kl*. Now bend the outstanding pieces, 2, 2, a

Fig. 1.

Cardboard as cut.

pieces are now bent and fastened, represents the central tooth of the gastric mill. Now bend 1 a little downwards upon 3, using *cd* as hinge, and bend 4 upon 5 very much, using *mn* as hinge. Finally, by means of thread or of fine wire, join the perforated corner of the pieces 6, 6, to the corresponding perforated corners of the pieces 2, 2, right to right and left to left, in such a way that the pieces 2, 2 lie outside the pieces 6, 6, and let the joint consist only of a single thread or wire, which may act as a pivot for rotation. In order to effect the joining of these pieces, the piece 6, 5, 6 will have to be bent like a bow, its right and left arms being deflected downwards and inwards.

The model is now complete. 1 represents the cardiac ossicle or sclerite; 2, 2, the two pterocardiacs; 3, the urocardiac; 4, the prepyloric; the shaded bit, together with the piece to which it has been affixed, now represents the median tooth, and projects downwards and forwards; 5, the pyloric sclerite; 6, 6, the right and left zygocardiacs; whilst 9, 9 represent the hori-

very little downwards, so that they stand at a slight angle to the piece 1.

Revolve the pieces 9 downwards upon the hinge lines *ab*, until each of them is brought into the same plane again as the piece 6, 5, 6. Fasten, by either gum or a knotted thread, the lower or unseen surface of the shaded bit of 9 flat against the lower face of the piece 6, 5, 6. Then bend the unshaded portion of each of the pieces 9, into a plane at right angles with the shaded portion, using the dotted line, *kl*, as hinge. These upstanding pieces 9, 9 represent the lateral teeth.

Now apply gum or a needle and thread to the shaded piece between 3 and 4, bending the whole piece 1, 3, 4, upon the hinge-line *gh*, until the shaded bit lies flat upon the surface of 4, to which it is to be securely joined. Bend back the piece 1, 3, using *ef* as hinge, until it lies in a plane at right angles to that of 4. The projecting termination of 4, as the

Fig. 2.

The apparatus complete: at rest.

Fig. 3.

The apparatus complete: in a state of tension.

Fig. 4.

zontally placed lateral teeth. The anterior and posterior processes, 8, 8 and 7, 7, represent respectively the anterior and posterior gastric muscles which are affixed in the position indicated and to the firm wall of the carapace. If we now pull upon these pieces so as to represent the effect of a muscular contraction, we shall find that the three teeth come together with a clash, but are again separated and the whole apparatus brought to its original condition by the elasticity of the cardboard. Again and again the clashing of the teeth can be effected by the tension applied at 8 and 9, just as it is in the living crayfish. If the parts representing the three teeth be very carefully adjusted as to size and direction, and be covered with some hard substance, such as sealing-wax (applied after solution in spirit), they may be made really to grind soft substances, such as bread, into fragments.

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University College, Gower Street, February 4

Modern Chromatics

IN NATURE, vol. xxi, p. 78, is a review of a book of mine, "Modern Chromatics," by Silvanus P. Thompson, that contains one or two points that I ought perhaps not to allow to pass without notice. The statement is made by the reviewer that I claim as mine a certain experiment which was originally described in England by T. Rose. I find, however, on examination, that Mr. Rose read his paper on this subject before the British Association in 1861, while mine was published in September, 1860, in the *American Journal of Science and Arts*. In the same

review it also stated or implied that I am in error in saying that in blue eyes there is no real blue colouring matter, but that the blue hue is due to the presence of a turbid (or opalescent) medium. Essentially the same statement with details will be found on p. 14 of Helmholtz's "Physiological Optics," also on p. 610 of Dalton's "Human Physiology." In his "Physiologie der Farben," on p. 95, Brücke remarks:—"In the most beautiful blue eye there is no trace of any blue colouring matter."

If any real blue pigment has been discovered in the iris of the human eye, it would interest me to know when and by whom.

The reviewer also intimates that I am in error in stating that