

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

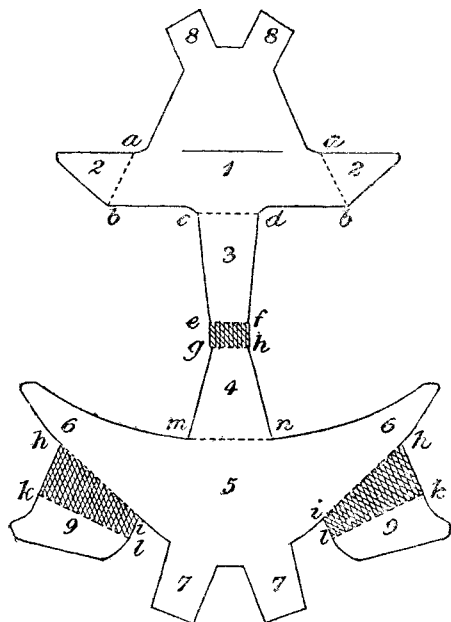


Fig. 1.

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

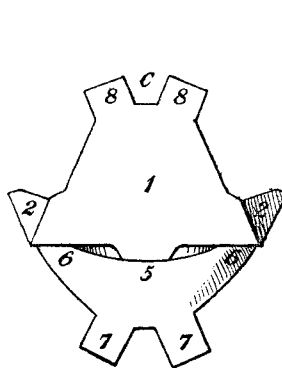


Fig. 2.

The apparatus complete: at rest.

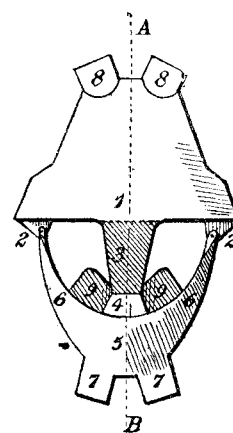


Fig. 3.

The apparatus complete: in a state of tension.

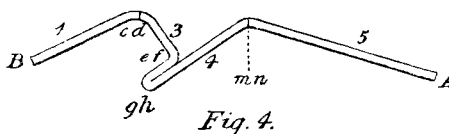


Fig. 4.

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.

W. E. ROTH

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

the colours displayed by the photographs obtained by Becquerel and other earlier experimenters from coloured objects, were due merely to the interference of the rays of light reflected from the plates, that is, were the colours of turbid media. The conclusion reached by me was based on a repetition in 1853 of Becquerel's experiments, on a personal examination of two of the coloured photographs of Niépce, and on the results obtained by C. Schultz-Sellack, *Pogg. Ann.* for 1871, p. 449; and finally, in a more general way, on a prolonged photographic experience in which colours were not unfrequently obtained by myself that imitated those of nature, but were really due to the interference of light.

OGDEN N. ROOD

New York, January

[It is a matter of regret that Prof. Rood should misunderstand the entire tone of a passage which occurs in my review of his admirable work on "Modern Chromatics." In the passage referred to I stated that there were one or two points which would be better revised whenever a second edition should be called for: these being statements set down without any qualification whatsoever, but which are not universally accepted, and which, as being still matters not removed from the field of controversy, should not be stated without reserve in a text-book where space forbids discussion or extended reference. There are physiologists who do not accept without some qualification Helmholtz's statement that the blue tint of eyes is simply due to turbidity of the medium. The most eminent authorities on the subject in this country do not accept the view that the beautiful photographs in colours obtained by Becquerel and others are *merely* due to interference of light, in fact their opinion is the very reverse. Hence, while the sentence to which I have taken exception may be regarded as Prof. Rood's *opinion*, it cannot be regarded as a universally accepted view; and that is all I have desired to intimate.

As to the experiment with the rotating disk claimed by Prof. Rood, there is no doubt whatever that he has the *priority*. It is, however, literally true that the experiment, which Prof. Rood claims (and rightly claims) as his own, was originally described in England by Mr. T. Rose in 1861. Nothing was further from the writer's intention than to charge Prof. Rood with plagiarism for describing the same experiment in America in 1860.—S. P. T.]

Etna

PROF. O. SILVESTRI writes me in a letter dated Catania, February 12:—"L'Etna dal 10 febbrajo presenta fenomeni eruttivi dentro al cratere centrale e ci ha dato una pioggia di cenere che ha ricoperto tutta la neve sul fianco Est-Sud-Est." Some of the ash inclosed in the letter is grey in colour, exactly like pulverised basalt. Under a high power it is seen to consist of minute transparent tabular crystals (probably felspar), mixed with greenish and brownish particles. The mud craters near Paterno have lately exhibited increased activity, and slight shocks of earthquake have been felt on the north-east and south west sides of the mountain.

G. F. RODWELL

February 23

Ice-Crystals and Filaments

If the Duke of Argyll will look again at the second of the three letters in *NATURE*, vol. xxi, p. 302, he will see that, although my explanation of the ice-filaments agrees on the whole with those contained in the other two, it differs in one important respect, and is not liable to the chief objection which he alleges against the theory. I suppose the crystallisation of the water to go on *pari passu* with its exudation at the surface of the rotten wood. If the wood be saturated with water the water will begin to exude by expansion as soon as its temperature falls below 4° C., that is, before it becomes frozen. Now the temperature at the surface will fall more rapidly by radiation than that within by conduction. Consequently the water will for the first time be subjected to a freezing temperature when it gets beyond the surface. There it will be solidified, and by the coating of crystals formed, help to protect the water within from freezing. It may possibly be that the slight relief from pressure which the water would experience on escaping from constraint when it arrives at the free surface would predispose it to immediate solidification.

A very similar arrangement of crystals of salts of lime may be observed occasionally to exude from plastered walls, strongly

confirming the supposition that the water of which the filamentous crystals in the present case are composed comes from within and is not deposited as a form of hoar frost from without.

Harlton, Cambridge, February 20

O. FISHER

I AM astonished at the Duke of Argyll's first letter (*NATURE*, vol. xxi, p. 274) not having received a more adequate answer from nearer home. The explanation of the phenomenon in question is to be found in the action of capillary attraction (as stated by Mr. King, p. 302), together with the growth of crystals by absorption from surrounding media; in this case from fog and watery vapour in the air.

Comb-shaped masses of ice, of a decidedly fibrous structure, and several inches high, are to be observed here every winter, extending over wide ranges on the loose and porous soil of the wooded hills near Freiburg, especially on inclined path-borders devoid of vegetation. They are found most abundantly when fogs have prevailed for a longer period, with the temperature below freezing-point, as has been the case these last months. These filamentary masses are formed at the same times and from the same causes as the hoar frost on trees, grass, &c., but of course they are much more durable than the latter, being of a much coarser texture, and not exposed to the destructive action of the winds and of the sun's rays. They are, moreover, protected by grains and clusters of soil raised by the growth of the filaments, and sometimes forming a covering sufficient to conceal the icy masses from a superficial inspection, the structure being surprisingly revealed by a stick's stroke.

During the extraordinarily protracted frost-period of last January, a snow-sheet of a few inches only persisted round about here for several weeks. Meanwhile we have had extremely quiet air (with high barometer) and fogs of varying density, only interrupted sometimes by a few hours of sunshine about noon. Now a very remarkable consequence of this state of weather was to be observed, offering, as it were, another proof for the explanation given above. The thin snow-cover served as a soil, from which grew up everywhere the most beautiful and delicate crystalline structures, forming a superimposed stratum, in many places of much greater height than the snow-crust, on which it arose, but, of course, of a very loose cohesion. This, no doubt, is the same phenomenon as that mentioned in the beginning of the Duke of Argyll's first letter, being due, likewise, to the attraction continually exercised by crystals of ice and snow on the watery vapour of the cold air. The crystalline fern-growths in these cases, and the fibrous masses in and upon the porous soil may be considered as equivalent, the condensation of vapour being more abundant, and producing fibrous instead of more delicate crystalline structures, when taking place on and between loose earthy (or wooden) particles.

Undoubtedly such phenomena have been oftentimes observed in many countries. A careful and detailed description (with illustrations) entitled "Ueber Eiskrystalle in lockerem Schutte," has been given by Dr. G. A. Koch in the *Neues Jahrbuch für Mineralogie*, 1877, p. 449, especially considering these structures from a crystallographical point of view.

Freiburg im Breisgau, February 21

D. WETTERHAN

"Scientific Jokes"

WILL Mr. Moulton compassionate my ignorance, and explain to me (and to many others equally uninformed, and equally thirsting for information) *in what sense it is true* that "The energy of heat is made up of heat and temperature." I have been taught that heat is energy. If this be true, the energy of heat cannot depend on temperature.

I would also beg for an explanation of the statement that "Force is the power of producing energy." I have been taught that energy cannot be produced or destroyed by any natural process whatever.

As to the explanation of the earth's magnetism, I should have said that Prof. Rowland was the first to imagine it (as he was the discoverer of the beautiful result on which it is based), but he saw at once its incompatibility with known facts. His trenchant note in the *Philosophical Magazine* for last August, in which he points out "more exactly" Messrs. Ayrton and Perry's error, has not yet (to my knowledge) been answered. And no wonder; for an error of nearly sixty thousand million per cent. is not easily got over!

G. H.