or even the possibility of estrogenic stimulation of the production of mammogenic hormones by the pituitary, the present experiments offer no support for the view that administered estrogens necessarily stimulate mammary growth through the mediation of the pituitary. For if such were the case, a similar growth response would be expected in both glands, rather than the local, unilateral effect observed.

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THE CONTROL OF PROTOPLASMIC STREAMING

PROTOPLASMIC streaming owes its existence to a motive force the magnitude of which has heretofore not been measured. In order that this might be done the technique here described has been developed.

The slime mold, *Physarum polycephalum,* served as material. Protoplasmic streaming in slime molds is extraordinarily active and exhibits a rhythmic reversal in direction of flow.

Small bits of plasmodia placed on cover-glasses coated with agar soon spread into thin sheets, which later develop protoplasmic strands. Among such cultures there are forms which can be changed so that there are two protoplasmic bodies connected by a single strand. A plasmodium thus shaped is inverted over a chamber which is divided into two compartments (A and B, Fig. 1) by an agar block (C, Fig. 1).

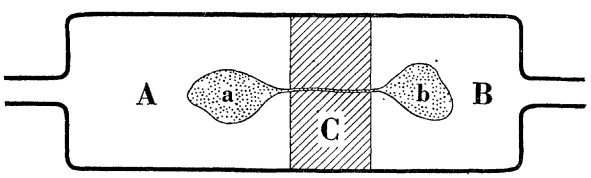

FIG. 1. Schematic representation of the chamber.

The construction is such that the two compartments may be kept airtight without the wall separating them blocking protoplasmic flow in the connecting strand. One of the two compartments is kept at constant atmospheric pressure, whereas the pressure in the other compartment is under control.

When there is no pressure difference between the two compartments, the shuttle movement of the protoplasm goes on normally, causing a corresponding change in the volume of the two protoplasmic masses (A and B, Fig. 1). When, however, a difference in air pressure is established between the two compartments, the movement of the protoplasm in the connecting strand is strikingly affected. If a slightly lower pressure (weak vacuum) is applied to one of the compartments, the flow of the protoplasm in the connecting strand into that compartment is accelerated. When a slightly higher pressure is applied to the same compartment, the flow of the protoplasm along the connecting strand into that compartment is retarded. If the pressure applied is stronger than the motive force developed in the plasmodium, then the forward-moving protoplasm is forced backwards. The direction and velocity of the protoplasmic movement in the connecting strand can thus be accurately controlled. Artificial control of protoplasmic streaming in this manner does not cause any observable damage. Flow continues normally after the applied pressure is released.

By this method it is possible to ascertain the precise degree of pressure necessary to hold the protoplasm at a standstill. The pressure at this point, which is regarded as equal in absolute value to the motive force responsible for the protoplasmic streaming, may be termed the balance-pressure. The range of the balance-pressure is usually between $\pm$ 20 cm of water. The maximum absolute value thus far encountered is 28 cm of water. So sensitive is the movement of the protoplasm that the slightest deviation (less than 0.2 cm of water) from the point of balance-pressure will induce movement in an 8 mm connecting strand.

As the motive force changes spontaneously, the balance-pressure must be adjusted accordingly, if the protoplasm is to be kept immobile. In order to determine in what manner and to what extent the motive force changes in relation to time, the instantaneous values of the balance-pressures (*i.e.,* the values taken at any given instant) are recorded at five-second intervals. By plotting a series of these values as ordinates against time as abscissas, undulating curves are obtained which faithfully portray the distinguishing features of the changes which the motive force undergoes during the rhythmic succession of vital processes. The graphs thus obtained give a complete view of the rhythm in protoplasmic activity. All characteristics of rhythm such as wave form, frequency, polarity and amplitude are portrayed by the graphical representation.

The study of many examples of wave trains mapped in this way leads to the conclusion that the characteristic change in amplitude and in form of wave is, in all probability, due to the interference of different rhythms. This concept necessarily implies the co-existence, in one and the same plasmodium, of different frequencies of the mechanism responsible for the motive force. In other words, a plasmodium is a polyrhythmic system.

In this brief note I am not in a position to go into further details of description and discussion of my experiments, except to say that in addition to an analysis of protoplasmic rhythm the method here touched upon is a means for attacking such problems as that of the relative influence of motive force and viscosity in protoplasmic flow. The procedure outlined above also suggests a new method for measuring protoplasmic viscosity by applying the principle of

the capillary viscometer which so far has been used only for non-living substances.

My special appreciation is due to Professor William Seifriz for his unfailing interest and critical supervision. This investigation was aided by a grant from Mrs. Curtin Winsor, to whom I wish to express my most sincere thanks.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF MOUNTING SMALL EXHIBIT SPECIMENS OF MAMMALS AND BIRDS

AT regular intervals most scientists are confronted with the problem of presenting their work graphically to boards, patrons or laity. Biologists and medical researchers frequently must prepare taxidermic specimens used in their studies for such exhibits or for permanent museum record. Because an expense account seldom envisages the preparation of these demonstrations, professional assistance can not be readily procured.

It is for the above reasons that I believe my simple method of mounting small mammals is worth placing on record. This technique was first applied to mouse specimens exhibited at the Harvard Tercentenary in 1936, and more recently it has been employed on rats for the museum collections of the Wistar Institute, where they will be pointed out upon request. There is no reason why this method can not be readily extended with modifications to small birds and mammals generally.

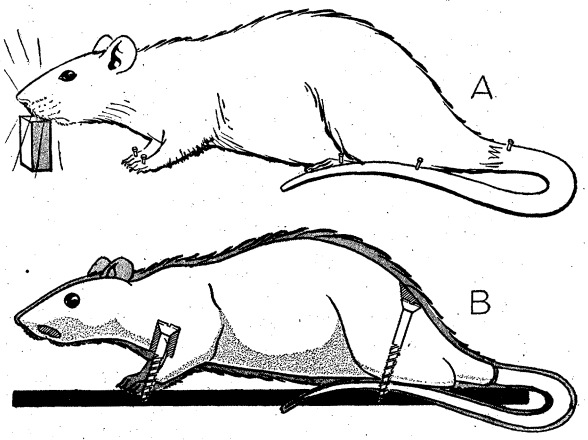
For the sake of simplicity I shall here describe the method as applied to the rat. First, kill the rat with a lethal dose of ether, chloroform or by some other method that will not harm the anatomy.

Inject 10 cc of 40 per cent. formaldehyde into the thoracic cavity and another 10 cc into the abdominal cavity, massaging the animal to distribute the injection fluid within the body cavities. Inject small amounts into the legs and subcutaneously over the body.

Within 15 minutes to half an hour subsequent to this injection the body will stiffen. When fairly rigid, place the rat upon a small temporary base-block of wood in the position desired for the finished specimen. Brad the rat's tail to the block. Then brad the four feet to their proper positions bending the body into the pose desired. The hips may be prevented from moving laterally by hammering several 7-penny nails into the block adjacent to the hips. The head may be held up by resting the teeth on a block of proper dimensions. See Fig. A.

When the animal is in the position desired, allow it to stand an hour or so until it has completely hardened.

Invert the specimen and wash it thoroughly under a faucet so water will wet the whole outer surface of the skin. Place the inverted specimen, block and all,



FIGS. A and B.

into a jar of formalin and allow it to stand 24 hours. The previous washing removes all air caught in the fur that might prevent areas of the skin from coming in contact with formalin.

After the specimen has cured 24 hours in formalin, wash under the faucet for a few minutes to remove all traces of formalin, which will attack the skin of the operator's hands, unless they are otherwise protected.

Lay the specimen on its back, and with a sharp razor blade cut the skin along the mid-ventral line from throat to genitals. Cross-slit between the two wrists and also between the two ankles. Now skin the animal. Wash from time to time to remove formalin from the interior. Sever the feet, leaving them attached to the skin of the legs. By first rolling the tail vigorously, the skin of this appendage may be readily slipped off. If difficulty is here encountered, a slit may be made along the ventral surface of the tail.

The detached skin, which tends to retain the shape of the posed specimen, is put back into the jar of formalin to harden further.

The body is then placed in its normal position in a small box to support the body mold which is cast from hide glue, plaster or a recently patented substance known as Plastico which has an agar base. When the mold has hardened, slit it longitudinally and remove the body. Cast a duplicate body in the mold with plaster or wax, preferably the former. Any projections produced in casting the body may be cut away with a knife and any depressions that may occur can be filled with Plasticine. The tail skin