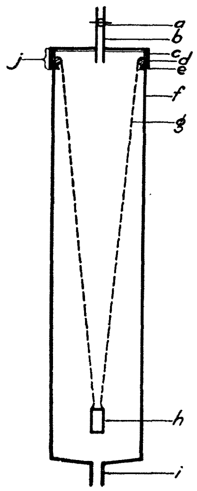

Fig. 1.

brass cylinder (f) to protect the net and to receive the filtered water. The inlet (b) brings the water from outside the ship's hull and the outlet (i) delivers the filtered water to the ship's bilge. The net, of 25 X bolting silk, is fastened in the usual manner by a canvas head to a brass ring (d) which rests on four lugs (e) to support the net in the cylinder. A cover (c) with a close-sliding joint at (j) permits the opening of the cylinder to change nets when necessary.

One may start using the apparatus at any time by allowing water to flow through the net at a desired rate and, since the head of water pressure between the valve (a) in the inlet and the surface of the sea is fixed, a uniform rate of flow is obtained when the vessel is underway except in a heavy sea. Thus the collecting time and the rate of flow give a close approximation of the quantity of water filtered. At given intervals the nets are quickly changed in the cylinder and the plankton collected is washed down into the plankton bucket (h), transferred to containers and preserved for further investigation of the volume, population and distribution of the various forms. This procedure allows a continuous collection of the surface plankton in any body of water through which the vessel may pass.

The size of the apparatus may be altered to permit the collection of the quantity of plankton desired in any given length of time by changing the rate of flow of the sea water and the filtering area of the net. In the apparatus used by the writer for phytoplankton the six millimeter inlet permitted the flow of two liters of sea water per minute and it was filtered through a 25 X silk net in the shape of a right cone with a radius of five centimeters and a height of thirty centimeters. The largest quantity collected during a twenty-minute period was thirty-six cubic centimeters of sedimented plankton, measured in a graduated cylinder after allowing sedimentation for three days. It was found that a representative qualitative and roughly quantitative collection of the surface phytoplankton could be made by this method.

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SPECIAL ARTICLES

ELECTRICAL EXCITATION OF THE NERVOUS SYSTEM—INTRODUCING A NEW PRINCIPLE: REMOTE CONTROL. PRELIMINARY REPORT[1]

A brief description is given herein of an apparatus designed for the purpose of removing the restrictions of time, anesthesia and restraint from experimental exploration of functions susceptible to electrical excitation. It provides a wide range of control of current, frequency and of the individual wave contour.

In this method a small secondary coil, usually of 2,000 turns of copper wire, is actually implanted in an animal and one or both of its electrodes are taken to excitable centers. The wound is closed and after the animal recovers he is placed within the magnetic field created by a specially designed primary circuit. Two systems have been provided. One is intended for experiments of short duration in which the operator can maintain the position of the secondary coil parallel to that of the primary. The other consists of three primary coils set at right angles to each other, and the discharges are commutated successively through each of these coils, so that an animal placed in a cage within the coils receives a fairly uniform intensity of stimulation, no matter what position he may assume with respect to the coils.

In the single-coil system direct current, variable up to 450 volts, charges a bank of condensers of 80 microfarads' capacity, and these are discharged by means of a special mercury-pool tube through a primary coil of one to five turns which has a diameter of 36 inches. In the case of the triple-coil system a wooden box is built within the coils of sufficient size to accommodate a monkey for periods of several weeks, and his movements about the cage are attended by surprisingly small variations in the intensity of stimulus. Control is provided for a wide range of the frequency of discharge (from impulses separated by intervals of several seconds, to frequencies of 100 impulses or more per second); for voltage regulation; and for variations of the tuned

[1] From the Research Laboratory of Physics, Harvard University, and the Research Laboratory of the Department of Surgery, Yale University School of Medicine.

frequency of the primary circuit. The latter characteristic determines the duration of individual shocks, which are of the order of the chronaxie of mammalian nerve and muscle. The apparatus functions without moving parts and is apparently capable of giving weeks of uninterrupted service.

With tests made thus far we have produced typical Jacksonian attacks from stimulation of the motor area in the monkey; a condition of somnolence after stimulation of the hypothalamic region; contraction of the tongue from implantation of the electrode on the hypoglossal nerve; a copious flow of highly acid gastric juice, and violent peristalsis, from stimulation of the vagus on the lower esophagus of a dog. The implanted coils are covered with collodion, and some of these have now remained in place for as long as seven months without evidence of irritation of tissue or of cyst formation.

It is hoped that this apparatus will make possible the study of functions which do not yield to stimulation of short periods but which may respond during experiments in which the excitation simulates the character of that function and goes on, day and night, without disturbing in any way the habits or activity of the animal. It should be particularly useful, therefore, in the study of the nervous control of autonomic functions such as sleep, sugar and water metabolism, menstruation, blood pressure, normal and possibly abnormal digestive activity and temperature control.

A complete report of this apparatus is in preparation and will be published shortly.

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A SECOND METHOD OF CONTRACTION IN THE STRIATED MUSCLE OF SOME VERTEBRATE ANIMALS

THE visible structure of the contraction pattern in striated muscle, with its regularly arranged and equidistant M stripes, N stripes and Z stripes, is too well known to need description here. Also, some of the changes which take place in this pattern during contraction and relaxation have been extensively studied and described from living and dead material, from stained sections and under the polariscope.

Some time ago the writer cut bits of somatic muscle from the tail region of a still living torpedo or crampfish (Tetronarcine) captured at Woods Hole, Mass., and fixed them in several media. Sections were then cut parallel to the muscle fibers and their myofibrillae and stained for class demonstration in several staining fluids, iron haematoxylin proving the best.

The striation, as in most vertebrate muscle, was very fine, finer than most, but fairly plain. The fixation was very good and gave a true picture. The tissue was apparently caught by the fixation in a state of moderate relaxation. The individual myofibrils were large and plainly distinguishable in the fibers, which were very large and showed more cytoplasm than is usually seen in vertebrate muscle.

The peculiar features noted were broad and narrow areas running irregularly across the fibers approximately at right angles to these muscle fibers and showing considerable branching. A close examination showed that these areas or lines consisted of enlarged portions of successive contiguous myofibrils, these portions being swollen to a thickness greater than that of the rest of the myofibril and very much denser and deeper staining.

In fact, these areas presented exactly the picture seen in McGill's description and figures of the contraction areas in smooth muscle, and it was realized that we were dealing with a fully developed, voluntary striated muscle that was capable of contracting either by means of its highly specialized striated mechanism or, allowing this striated mechanism to lie idle, could contract in the same manner that a vertebrate smooth muscle does.

A close study with high power showed that these smooth muscle contraction areas bore no relation whatever to any part of the striations. The narrowest areas were narrower than a single unit of striation (from Z stripe to Z stripe). The broader ones included more than three or four of the striation units. As already indicated the linear areas formed bands that branched and they were disposed in an irregular fashion, which nevertheless enabled them to cover the field with some regularity.

It was noted that the fish and its tissues were still living when the material was cut out and fixed. Also that it was giving off electric shocks. The writer and Mr. George Meneely secured some living dogfish and skate material and tried to produce this condition experimentally. Muscle was exposed and subjected to electric stimulation, and, while contracting, cold and hot fixatives were applied. Some of these tissues when sectioned and stained showed the same condition. Mr. Meneely later got the same result with gastrocnemius muscle from the frog. Experiments are under way to see if it can be produced by drugs and by traumatic means. Also to study the innervation.

It is suggested that we have in these muscles a double innervation, from the central nervous system and the autonomic centers and that this second method of contraction occurs under the local influence of the