tagonistic action of stramonium toward the minimal convulsive dose of picrotoxin.

TABLE IV.
Antagonism of Stramonium (alcohol-free tincture) Toward the Minimal Convulsive Dose of Picrotoxin.

No. Rats	Stramonium*	Picrotoxin.	Result
10	.4 cc./100 gm.	.4 mg./100 gm.	Convulsions in 9 animals
10	.5 cc./100 gm.	.4 mg./100 gm.	Convulsions in 1 animal
10	.6 cc./100 gm.	.4 mg./100 gm.	No convulsions

* Each dose of stramonium given 10 minutes prior to picrotoxin injection.
Doses of 1.0 to 2.0 cc./100 gm. weight of the stramonium solution did not prevent the development of convulsions in rats given 0.5 mg. picrotoxin/100 gm.

Conclusions. 1. Stramonium exhibits an antagonistic action toward the convulsant stimulation of picrotoxin in rats. 2. The antagonistic action of stramonium is limited by an evident stimulant effect in large doses upon the central nervous system. 3. It is suggested that the stimulant action of stramonium in large doses upon the central nervous system may be, in part at least, an explanation of the therapeutic value of stramonium upon the partially destroyed cells of the *substantia nigra*, in the large doses found desirable in Parkinsonism. 4. There is a possibility that the picrotoxin-stramonium antagonism might serve as a means of the biological standardization of stramonium.

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A Piezo Electric Myograph.

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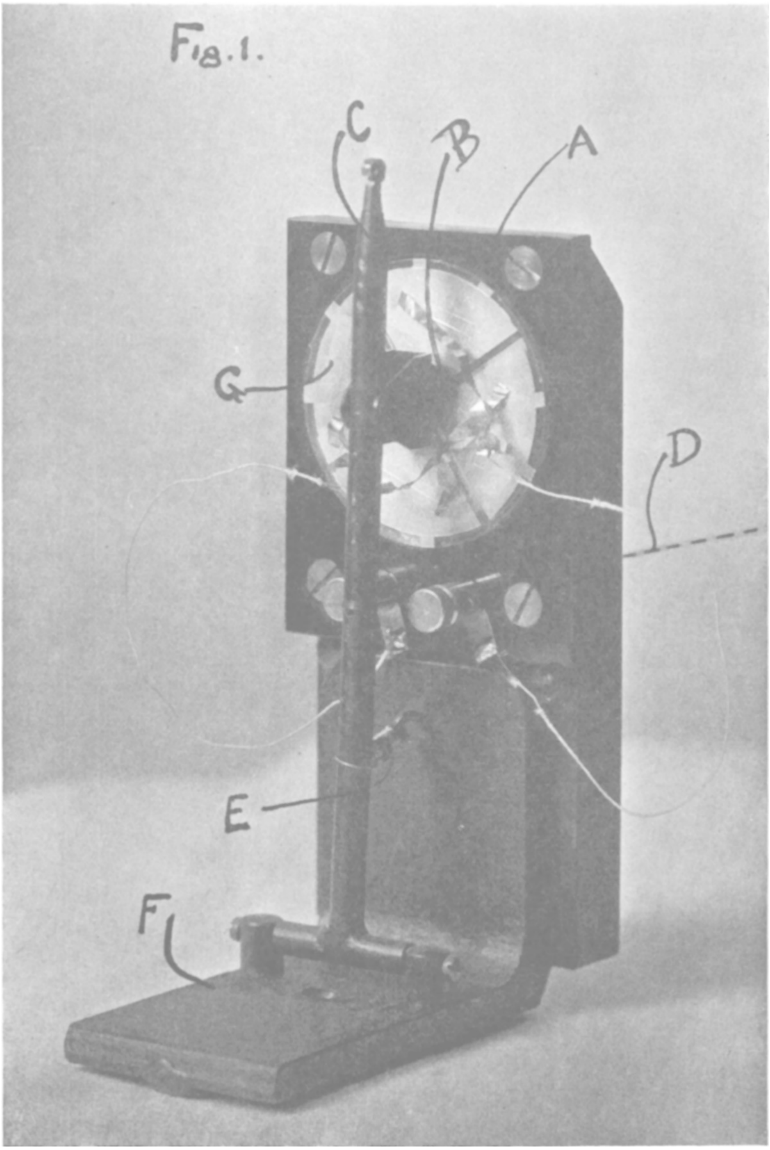
In the experiments here reported, the piezo-electric properties of Rochelle Salt crystal have been employed to record the tension developed by contracting muscle. For references to the literature on the piezo-electric effect the reader may consult the comprehensive bibliography of W. G. Cady.[1] The widespread use of the piezo-electric effect for measuring forces and pressures lead to its consideration as a means of recording muscular tension. It offers an instantaneous response without friction, inertia or moving parts, which is particularly well adapted to the measurement of the tension devel-

[1] Cady, W. G., *Proc. Inst. Radio Engineers*, 1928, **16**, 521.



oped in striated muscle in an isometric contraction in which tension rises to a maximum in about 30 sigma. Although our work is incomplete, the results obtained indicate the useful possibilities of the method.

Through the courtesy of C. Baldwin Sawyer of the Brush Development Laboratories, Cleveland, we were supplied with a Rochelle salt crystal designed especially for muscle physiology. This crystal, G, Fig. 1, is a flat cylinder 6.4 cm. x 0.6 cm., made from 2 identical plates each about 0.3 cm. thick, cemented together. These plates, which were derived from a specially grown crystal, were cut in such a way that the flat surface of the plate is parallel to the b and c axes of the crystal and perpendicular to the a axis. Before being cemented together the b and c axes of the 2 plates are rotated 90° from one another. There are quadrant electrodes of tin foil on each face and between the plates. The crystal was mounted in a frame of

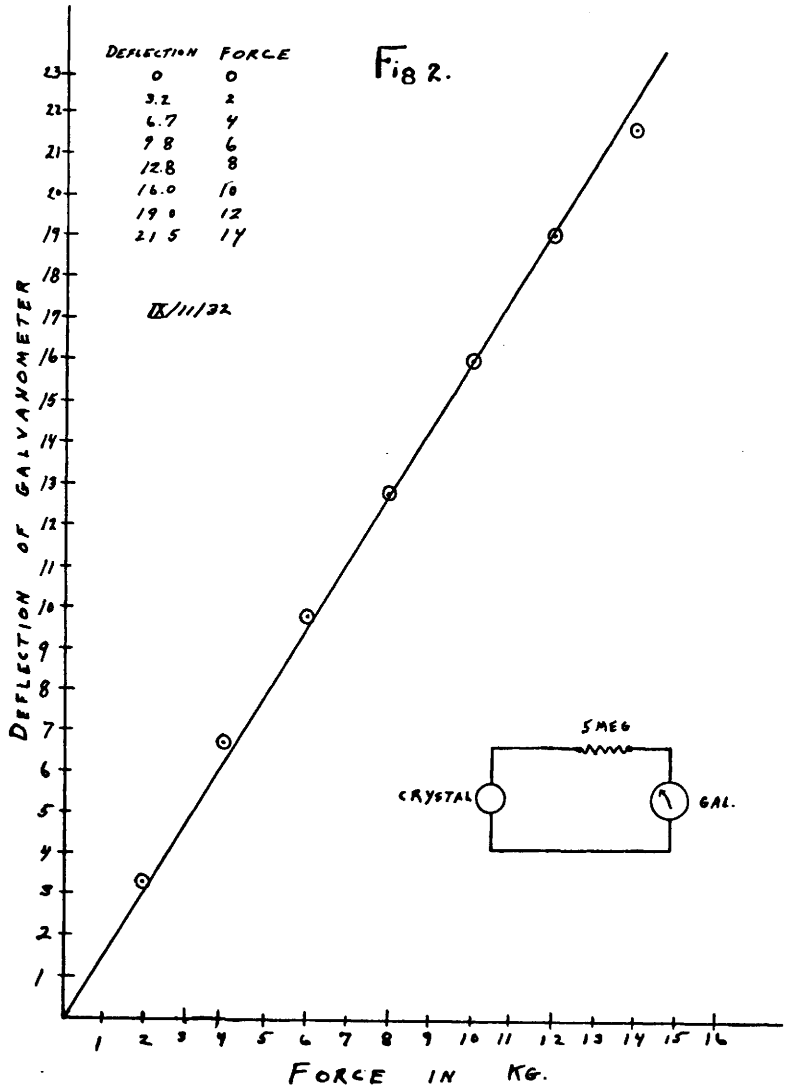
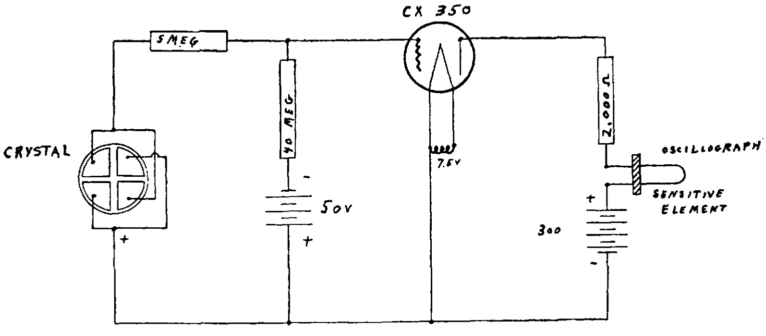


Fig. 3.



Bakelite, A (Fig. 1), and held in place by the pressure of a Bakelite disc, B, 1 cm. in diameter which was attached to the rod C, upon which force was exerted through the wire, D, which is attached to the muscle. A small spring, E, exerted a slight but sufficient pressure to hold the crystal snugly in place. The Bakelite frame is attached to a heavy angle-iron base, F, which may be clamped onto a slotted piece of channel iron.

The calibration of the crystal with respect to impressed force and E.M.F. output is shown in Fig. 2. This calibration was made by means of a Leeds and Northrup ballistic galvanometer Type P with 5 megohms in series. For measuring the E.M.F. output a second method was used in which the crystal was connected (Fig. 3) with the grid of a type 350 radio tube. Variations in the plate current with the grid potential were recorded by means of a Westinghouse oscillograph. The potentials developed by the crystal frequently reached 180 volts. This suggested the use of the inverted vacuum

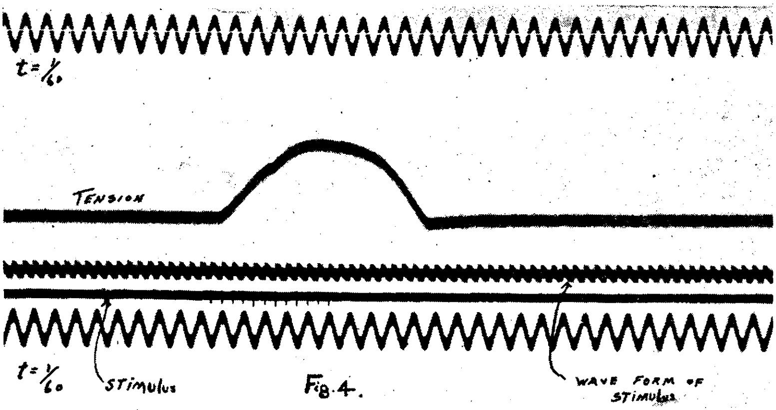


Fig. 4.

tube circuit with type 245 tube which operated quite satisfactorily. Since this work was done a new General Electric tube, type FP 110, has come on the market. The characteristics of this tube make it probable that, used in connection with the oscillograph, much more exact data may be obtained.

A piezo-electric, oscillographic, myogram is shown in Fig. 4. This was obtained by the hookup shown in Fig. 3 from the gastrocnemius muscle of a decerebrate cat (No. 492, ♀, wt. 1.8 kg.). The muscle was prepared with the tuber calcanei attached to the wire, D of Fig. 1. The initial tension was estimated at 200 gm. The muscle was stimulated through the tibial nerve by a series of 12 stimuli derived from a rectified 110 volt, 60 cycle a. c. current giving 120 pulses per second. The top and bottom lines of the record are time in 1/60 of a second. The second line is the oscillographic record of the changes in tension in the muscle registered by the E. M. F. which is developed in the crystal by the force exerted on it by the contracting muscle. The oscillographic record of the wave form of the stimulus is shown in the third line. Although the wave form of the stimulus is shown continuously on the record, only the 12 pulses shown in the fourth line were allowed to reach the nerve and cause muscular contraction. The absence of a "nose", plateau and angle in the myogram is in agreement with the findings of Cooper and Eccles[2] in which they show that a myogram obtained with a frictionless torsion wire myograph is devoid of discontinuities. The rather slow ascent of the myogram may be influenced by leakage from the crystal. As regards the permanence of the crystal, Sawyer[3] states "the crystal is not hygroscopic. * * * * The life of the crystal is indefinite, and it will not fail from atmospheric variations, or from 'fatigue'."

Since writing this article we have found two references in the literature. A piezo-electric myograph in which a quartz crystal has been employed, has been described by A. M. Monnier (*C. R. Acad. Sci.*, 1931, **195**, 1487). The instrument is figured but no myogram is shown. J. Sosnoski (*Am. J. Physiol.*, 1929, **90**, 524) reported at the 13th International Physiological Congress, experiments with a quartz crystal the emf. of which actuated a string galvanometer. No records are shown.

Also tube F.P. 110 has been tried and found to work very satisfactorily.

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[2] Cooper, S., and Eccles, J. C., *J. Physiol. Proc. Soc.*, 1930, **1**.

[3] Sawyer, C. B., *Proc. Inst. Rad. Eng.*, 1931, **19**, 2029.