14083

Magnetic Susceptibility of Beef Tendon.

K. S. Lion. (Introduced by F. O. Schmitt.)

From the Department of Biology and Biological Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

That tendon fibers show marked mechanical and optical anisotropy has long been known. In addition to these properties, the magnetic anisotropy of tendon has been studied. Measuring the magnetic susceptibility of beef tendon parallel and perpendicular to the fiber axis, Wöhlisch[1] concluded that the tendon shows positive paramagnetic properties, *i.e.*, the susceptibility is greater parallel than perpendicular to the fiber axis. His method was only qualitative, consisting of the observation of the rotation of the fiber freely suspended between the poles of a magnet, hence no numerical value for the susceptibility could be given.

While some degree of magnetic anisotropy is to be expected in such fibers it seems probable that, like most organic substances, they would be diamagnetic rather than paramagnetic. Gelatin, which is closely related to collagen, was found to be diamagnetic both in the dry form (Ambronn, quoted by Wöhlisch) and in approximately 1% solutions (Fallot[2]). The susceptibilities obtained by the latter investigator ranged between -0.76×10^{-6} and -0.91×10^{-6}.

In considering the cause of this apparent discrepancy it seemed possible that Wöhlisch's result may have been due to contamination of the material with traces of iron derived from the instruments with which the tendon was cut.

The magnetic susceptibility of iron at low field strength is of the order of 10^3. One gram of diamagnetic substance of the susceptibility of 10^{-6} will appear to be paramagnetic, therefore, if the content of iron is higher than 10^{-9} g.

If a sample consisting of such a mixture of a ferromagnetic and a (presumably) diamagnetic substance is brought into a nonhomogeneous magnetic field, two forces will act on the sample: one, resulting from the diamagnetic component, in one direction (Curve *A*, Fig. 1); the other, resulting from the ferromagnetic component, in the other direction

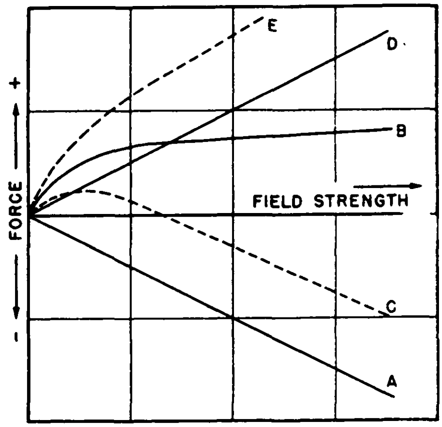

Fig. 1.

Forces acting on a body in a nonhomogeneous magnetic field. Body *A*—Diamagnetic, *B*—Ferromagnetic, *C*—Mixture of *A* and *B*, *D*—Paramagnetic, *E*—Mixture of *B* and *D*.

(Curve *B*). However, Curve *B* shows saturation with increased field strength. A mixture of a diamagnetic and a ferromagnetic substance is characterized by Curve *C*. If, on the other hand, the body is composed of a ferromagnetic and a paramagnetic substance, the force acting on it will correspond to the Curve *E*, resulting from a super-position of Curves *B* and *D*.

To test the correctness of this interpretation of Wöhlisch's result the following experiment was performed. The dried tendon fiber was suspended by a silk fiber from one arm of an analytical balance into the field of a large coreless magnet.* The force acting on the sample is:

[1] Wöhlisch, *Verh. d. physik.-med. Ges. Würzburg*, 1926, **51**, 63; *Z. f. Biologie*, 1926, **84**, 598.

[2] Fallot, *Comptes Rendues*, 1929, **188**, 1498.

* For the use of this magnet we are indebted to Prof. A. R. Kaufman of the Metallurgy Department of M.I.T.

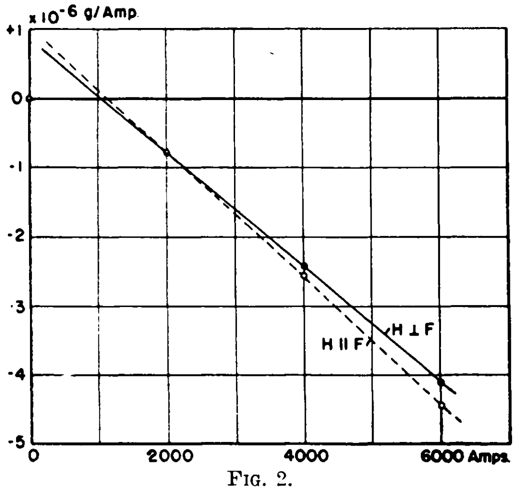

FIG. 2.
Explanation see text.

$$f = m \cdot \chi \cdot H \cdot \frac{\delta H}{\delta x}$$

where m is the mass, χ the susceptibility, H the strength of the magnetic field, and $\delta H/\delta x$ the inhomogeneity of the field in a vertical direction in the region occupied by the tendon. H could be varied from 0-36,000 Gauss by varying the current from 0-6,000 Amps.

Fig. 2 illustrates the results obtained. All measured points at field strengths above 6,000 Gauss show a deflection to the negative side, indicating that beef tendon is *diamagnetic.* The numerical value† of the susceptibility was found to be $-0.80_7 \cdot 10^{-6}$ parallel to the fiber axis, and $-0.85 \cdot 10^{-6}$ perpendicular to the fiber axis. The fiber is therefore *negatively diamagnetic.* The presence of traces of iron is assumed from the fact that the line connecting the measured points does not pass through the origin. It seems probable that Wöhlisch's anomalous result was due to a similar cause.

† Unfortunately only 2 experiments could be performed before the magnet was required for other purposes. The data are, therefore, not sufficient to establish accurately the absolute value of the susceptibility. However, the purpose of the work was to explain the anomalous results of Wöhlisch rather than to determine the numerical value of the susceptibility which, in itself, is not particularly significant.

14084

Response of Human Pregnant Uterus to Pitocin Tannate in Oil.*

ERNEST W. PAGE.
From the Division of Physiology and the Department of Obstetrics and Gynecology, University of California Medical School, Berkeley.

The posterior pituitary hormone was fractionated by Kamm and his associates[1] into the pressor-antidiuretic fraction (Pitressin) and the oxytocic fraction (Pitocin). Two years ago a preparation of Pitressin tannate in oil (a tannic acid precipitate of the Pitressin fraction resuspended in peanut oil) was utilized in the treatment of diabetes insipidus[2] because of its prolonged action. At this time a similar preparation of the Pitocin fraction was prepared† for clinical trial in the induction of labor and for uterine inertia. It was hoped that a more slowly absorbed oxytocic would produce a more physiologic response than the rapidly acting aqueous posterior pituitary hormone.

Methods. Injections of Pitocin tannate in oil were given to 22 women for the induction of labor at term and to 10 women whose labors were complicated by primary uterine inertia. In many instances a graphic record of the response was obtained by means of the Lorand

* Aided by a grant from the John and Mary Markle Foundation.

1 Kamm, O., Aldrich, T. B., Grote, I. W., Rowe, L. W., and Bugbee, E. P., *J. Am. Chem. Soc.*, 1928, **50**, 573.

2 Greene, J. A., and January, L. E., *J. A. M. A.*, 1940, **115**, 1183.

† The Pitocin tannate in oil was prepared and donated by Doctors Oliver Kamm and E. A. Sharp of Parke, Davis and Company.