the physiology and mechanics of the more elaborate and more abstruse systems of chromosome diminution found in animals.

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Compression of Cylinders of Soft Materials

SOME time ago, we proposed an equation[1] to describe the behaviour of soft bodies under compression, with special reference to the compression of cylinders. Whereas for a true fluid we have $\eta = s\sigma^{-1} t^1$, and for an elastic solid $n = s\sigma^{-1} t^0$; we proposed for 'intermediate' materials

$$\psi = s\sigma^{-1} t^k$$

where s is shearing stress, σ is shearing strain calculated by the logarithmic formula, t is time of compression, η is viscosity, n is shear modulus, and ψ was described as the "firmness" and k as "a measure of elasticity", though we should no longer care to use the latter expression, since such properties as work-hardening and dilatancy would reduce k without increasing the elastic recovery.

This equation obviates the difficulties, both practical and theoretical, involved in attempting to divide σ into two parts, recoverable and non-recoverable, in order to calculate η and n for such materials.

In a later paper[2], psychological experiments were described which we believe to justify the use of ψ as a criterion of firmness, in spite of, or rather because of, its peculiar physical dimensions. In neither paper was it possible to give any data to test the equation, nor was it claimed that ψ and k would be expected to be constants for all materials independent of stress and strain conditions. It was, however, hoped that the new treatment would prove simpler than the classical analysis, in which very complex variations in η and n with varying stress and strain conditions and histories are to be found[3].

A direct test of the equation has now been made possible as a result of the design and construction by Dr. P. White and Mr. J. Cotton of an apparatus, to be described shortly, in which cylinders can be loaded in such a way that the load increases proportionally to the change in cross-section of the cylinder, the value of s thus remaining constant throughout the compression.

Under these conditions, the equation may be written :

$$\log \psi = k \log t - \log \sigma + \text{const.} ;$$

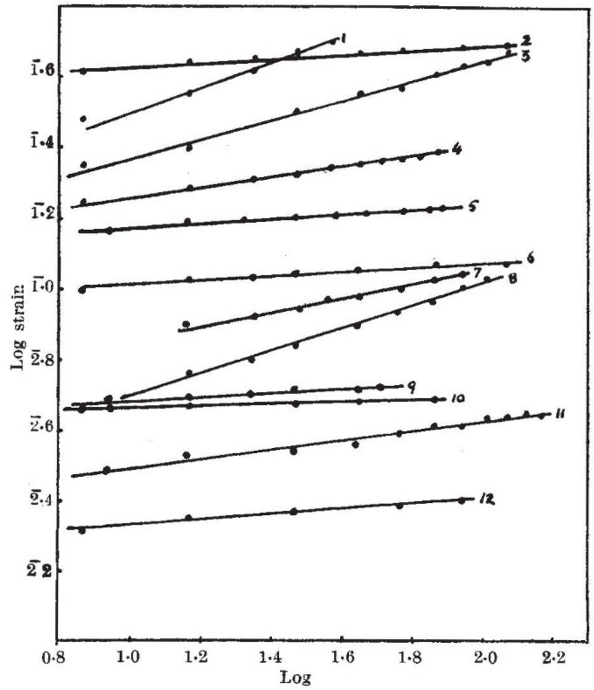
or, in the case where the log σ/log t curves are linear :

$$\log \psi = k - \log \sigma_{10} + \text{const.},$$

where σ_{10} is the strain produced in 10 sec.

In view of the principle underlying Fechner's law, it seems not unlikely that 'firmness' as judged subjectively may be related directly to log ψ, and for this reason as well as because the logarithmic values are easier to handle, we prefer to keep the data in the logarithmic form.

The new instrument was designed for experiments with cheese and butter, so that the stress range available is somewhat limited, but it has been possible



No.	Material	Radius	Shearing stress	Log ψ	k
1.	Worked butter	1·5 cm.	58,260 dyne cm.$^{-2}$	5·61	0·35
2.	Wet clay soil	1·0	131,100	5·53	0·035
3.	Rested butter	1·5	58,260	5·67	0·28
4.	Cake	1·0	102,500	5·89	0·14
5.	Acrylic acid polymer	1·0	192,600	6·18	0·06
6.	Mod. wet clay soil	1·0	131,100	6·17	0·055
7.	Cheddar cheese	1·0	131,100	6·47	0·20
8.	Stale bread	1·5	58,260	6·40	0·325
9.	Apple (flesh)	1·0	192,600	6·66	0·055
10.	Potato	1·0	192,600	6·66	0·035
11.	Plasticine-rubber Vaseline mixture	1·0	192,600	6·93	0·14
12.	Dry clay soil	1·0	131,100	6·86	0·07

to test, at a constant temperature of 60° F., a number of very varied materials, curves for some of which are shown in the accompanying graph. The log σ/log t curves are remarkably linear, except perhaps at very small strains, where measurements are, in any event, decidedly inaccurate.

Experiments with cylinders of Californian bitumen, which approximates very closely to truly fluid behaviour, indicate that the instrument is compensating correctly for the change in cross-section, unless exceptionally small loads are used. The only case where this error is likely to be just significant is for No. 4, but the curve is shown because of its intrinsic interest.

Our views as to the significance of k have altered in the light of experience with the apparatus. This will be discussed when the experiments are described more fully elsewhere.

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