reducing the shrinkage of woollen goods. 'Wet' chlorine and bromine treatments reduce the directional friction in alkaline media by decreasing both μ_1 and μ_2 to low values. Sulphuryl chloride treatment makes μ_2 approach μ_1 without greatly reducing the average friction. Alcoholic potash treatment increases both μ_1 and μ_2 in alkaline solution to approximately the same value.

In these preliminary experiments, horn was chosen as the second rubbing surface because it is chemically similar to wool and is more convenient to handle. A few experiments with wool fibre against wool fibre gave essentially the same results. Further work on this problem is continuing.

The above was written before I had an opportunity of seeing the recent communication by Whewell, Rigelhaupt and Selim⁴. These authors, using an 'angle of slip' method of measuring friction, have demonstrated changes in directional friction or cleanliness. Our conclusions are in agreement, except that they find a decreased directional friction in alkaline solutions. This may be due to the fact that their determination was made at pH 9.24. I have previously reported that under some conditions a minimum rate of felting occurs at this pH with an increased rate at higher pH's⁵.

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¹ *Proc. Roy. Soc., A*, 189, 371 (1939).

² *J. Text. Inst.*, 22, T 339 (1931).

³ *J. Text. Inst.*, 24, T 273 (1933).

⁴ *Nature*, 154, 772 (1944).

⁵ *J. Council Sci. Ind. Res. (Aust.)*, 15, 285 (1942)

Radioactivity of the Neutron

THE mass of the neutron (1.00893 m μ) is about 0.8 Mev. greater than that of the hydrogen atom (1.00813 m μ). We should expect that, from Fermi's theory, the neutron would be β -radioactive with a half-life period of about three hours, if the transition is not 'forbidden'. The fact that this radioactivity has never been actually observed is attributed to the extremely short life of the capture of the neutron by nuclei through which the neutron is passing (about 1.7×10^{-4} sec. in paraffin). We here propose a method which may be capable of detecting the decay of the neutron.

Let a strong source of neutrons be put near a paraffin block; and let the neutrons, after being slowed down by paraffin, be incident on a vessel containing partly liquid heavy hydrogen. Since the neutron capture cross-section ($\sigma_c = 2 \times 10^{-28}$ cm.²)¹ in the deuteron of the deuterium is only about one-thousandth of that of the nuclei in paraffin, we should expect the capture life-time for the slow neutrons of the former to be about one second. Within this time there is a measurable probability of the decay of the neutron. Thus the vessel containing liquid heavy

hydrogen, being exposed to slow neutrons for a certain time, must also contain hydrogen as the decay product of neutrons. The presence of these hydrogen atoms may be detected spectroscopically.

It may also be mentioned that the use of liquid helium instead of liquid heavy hydrogen would probably give better results, because the value of σ_c for neutrons in helium is probably smaller than in deuteron, although there is no experimental evidence for this up to the present.

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¹ Borst, L. B., and Harkins, W. D., *Phys. Rev.*, 57, 659 (1940).

A Simple Calculation of the Perihelion of Mercury from the Principle of Equivalence

IT is known that first-order phenomena described in the general theory of relativity can be deduced from the principle of equivalence. The present note serves as an illustration.

The principle of equivalence demands that the length along the field direction be deviated, to the first order of approximation, in the ratio: $dr: (1 + \lambda/r)dr$, where λ is GM/C^2 ; and that the time, dt , be modified into the expression $(1 + \lambda/r)^{-1}dt$. But the length normal to the field direction undergoes no change.

Hence the kinetic energy is expressible in the form $\frac{1}{2}(\beta^2\dot{r}^2 + \beta^2\dot{\theta}^2r^2)$ and the Lagrangian is accordingly $\frac{1}{2}(\beta^2\dot{r}^2 + \beta^2\dot{\theta}^2r^2) - V(r)$, where $V(r) = -GM/r$, $\beta = (1 + \lambda/r)$.

Now the equation of motion of a test body is

$$\frac{d}{dt}(\beta^2\dot{r}) - \beta^2r\dot{\theta}^2 - 2\dot{r}^2\frac{\partial\beta}{\partial r} - r^2\dot{\theta}^2\frac{\partial\beta}{\partial r} + \frac{\partial V}{\partial r} = 0, \quad (1)$$

$$\beta^2r^2\dot{\theta} = h (= \text{const.}), \quad (2)$$

where β denotes $(1 + \lambda/r)$.

Retaining only the first order of λ , we have from (1) and (2):

$$-\frac{h^2}{r^2\beta^2}\frac{d}{d\theta}\beta^2\frac{d\mu}{d\theta} - \frac{h^2}{\beta^2r^2}\mu = -GM\mu^2 - h^2\mu^4\lambda + 2\dot{r}\frac{\partial\beta}{\partial r},$$

$$\text{or } \frac{d}{d\theta}\beta^2\frac{d\mu}{d\theta} + \mu = \frac{GM}{h^2}\beta^2 + \lambda\mu^2 - 2\frac{r^2\dot{r}^2}{h^2}\frac{\partial\beta}{\partial r}.$$

$$\text{But } \frac{d}{d\theta}\beta^2\frac{d\mu}{d\theta} = \beta^2\frac{d^2\mu}{d\theta^2} - 2\frac{r^2\dot{r}^2}{h^2}\frac{d\beta}{dr};$$

$$\text{hence } \frac{d^2\mu}{d\theta^2} + \beta^{-2}\mu = \frac{GM}{h^2} + \lambda\mu^2,$$

$$\text{or } \frac{d^2\mu}{d\theta^2} + \mu = \frac{GM}{h^2} + 3\lambda\mu^2.$$

This is the same equation as that obtained from Schwarzschild's solution and the geodesic equation of a test body.

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