Liquid	Viscosity range (η poises $\times 10^3$)	Temperature range ($^{\circ}$ C.)	$\frac{\eta}{T}$ (10^3) range
1. 96.5 Fe: 3.5 C	29.0 to 17.5	1,250 to 1,400	1.9 to 1.0
2. 97.0 Fe: 3.0 C	28.0 " 20.3	1,300 " 1,400	1.8 " 1.2
3. 97.5 Fe: 2.5 C	26.5 " 22.5	1,350 " 1,400	1.6 " 1.3
4. Formic acid	23.9 " 5.58	7.6 " 97.2	8.5 " 1.5
5. Water	26.0 " 2.83	-10 " 70	9.9 " 1.2
6. Ethyl alcohol	17.9 " 15.4	0 " 70	6.6 " 4.5
7. Mercury	18.6 " 9.3	-20 " 300	7.3 " 1.6
8. Cadmium	14.4 " 11.0	349 " 603	2.3 " 1.3
9. Acetic acid	10.3 " 4.4	30 " 103	3.4 " 1.2
10. Carbon tetrachloride	13.3 " 5.0	0.6 " 74	4.8 " 1.5
11. Benzene	9.0 " 3.5	0 " 70	3.3 " 1.0
12. Methyl alcohol	8.1 " 3.5	0 " 60	3.0 " 1.0
13. Chloroform	7.9 " 4.2	-10 " 50	3.0 " 1.3
14. Ethyl ether	25.7 " 1.9	-110 " 40	15.7 " 0.6
15. <i>n</i> -Heptane	4.8 " 2.1	6.4 " 92.2	1.7 " 0.6
16. Carbon disulphide	4.3 " 3.1	0.4 " 45.9	1.6 " 0.9
17. * <i>p</i> -Xylene	7.5 " 2.3	8.3 " 135.2	2.8 " 0.6
18. *Synthetic oils	29,310 to 88.5	-30 to 61	120 to 0.1
19. *Baku bitumens	21,210 " 25.5	40.0 " 100	67.6 " 0.07
20. *Molasses	109.7 " 5.4	70 " 120	0.3 " 0.01

* Not shown in the diagram.

straight line appear, particularly at low temperatures¹, and in the case of the polyglycols, polymethylsiloxanes, halocarbons and 'Ucon' fluids². These deviations have been variously explained at low temperatures by thixotropy, and at high temperatures by thermal agitation, loss of hydrated water, and statistical uncoiling of long-chain molecules. While such effects may occur, some of the explanations appear speculative.

It cannot be concluded that existing methods of representing viscosity temperature data are entirely satisfactory, particularly over the extended ranges of temperatures modern usage encounters.

From the form of the viscosity-temperature curve of a liquid it was suspected that a simple equation would apply, of the type

$$\eta(1 - a/T) = b \quad (2)$$

$$\text{or } \eta = a\eta/T + b, \quad (2a)$$

where η is in poises; a and b are constants.

Equation 2a has been investigated for the miscellaneous liquids given in the accompanying table. In the graph, η has been plotted against η/T and, as may be seen, the linear relationship holds over the temperature-ranges recorded. In the region of the boiling points, deviations appeared; but not at low temperatures, where thixotropic effects have been reported.

A. V. BRANCKER

35 Kendal Street, London, W.2.

Sept. 1.

¹ Ramaiya, K. S., *Symp. on Visc. of Liquids and Colloidal Solutions*, Acad. Sci. U.S.S.R., 2, 178 (1944).

² Murphy, C. M., Romans, J. R., and Zisman, W. A., *Trans. Amer. Soc. Mech. Eng.*, 71, 561 (1949).

The Spin and Magnetic Moment of the Rhodium Nucleus

NATURALLY occurring rhodium consists almost entirely of one isotope, ^{103}Rh . No hyperfine structure has previously been found, nor has a determination of the nuclear spin by any other method been made. By passing light from a hollow-cathode tube containing rhodium through an atomic beam of rhodium, we were able to observe absorption in one of the resonance lines, 3434.90 Å. ($4d^5s$ $^4F_{9/2} - 4d^5p$ $^4G_{11/2}$). The absorption spectrum shows a well-resolved doublet, of splitting 0.023 cm.⁻¹. This proves conclusively that the nuclear spin has the value $I = \frac{1}{2}$, since any other value would produce a quartet or

higher multiplet. The splitting of the line must be attributed to the ground-term, which contains an unpaired s -electron. If perfect Russell-Saunders coupling is assumed, the value of the magnetic moment can be calculated by means of the conventional approximation methods. It is found to be -0.11 nuclear magnetons. This is one of the smallest magnetic moments so far reported.

The negative sign is not quite certain. It is derived from the observation that the component of shorter wave-length appears to be the stronger. We are attempting to confirm this by further experiments.

H. KUHN

G. K. WOODGATE

Clarendon Laboratory,
Oxford. July 24.

¹ Meggers, W. F., and Kiess, C. C., *J. Opt. Soc. Amer.*, 12, 417 (1926).

² Mayer, M. G., *Phys. Rev.*, 78, 16 (1950).

³ Feenberg, E., and Hammack, K. C., *Phys. Rev.*, 75, 1877 (1949).

Distribution of Range-finding Errors

THE optical range-finder measures range by what is ultimately a visual estimation of the angle subtended by its base at the target. Thus

$$R = \frac{b}{\theta}, \quad \delta R \simeq -\frac{R^2}{b} \delta \theta. \quad (1)$$

Consequently, for a given type of instrument the customary measure of error used is $\delta R/R^2$. This will be approximately proportional to $\delta \theta$ and can be used for combining or comparing errors of measurements on targets at different ranges.

In some recent trials a considerable number of estimates of ranges to targets at accurately surveyed distances was made. The frequency distribution of errors expressed in the form

$$y = \text{range error}/(\text{true range})^2$$

departed significantly from the normal form. More unexpectedly, it showed significant skewness, there being a marked excess of large positive errors. The accompanying table compares observed percentages with those expected on the basis of a normal distribution.

While the distribution of errors in visual measurements of angle is probably far from normal, there is every reason to expect it to be symmetrical. The reason for the skewness observed lies in the approximation used in (1). This approximation implies that range errors of equal magnitude will result from angular errors of the same size but of opposite signs.