Although testing of samples has not been completed nor the information fully analysed, a number of observations can be made. No frozen ground was encountered throughout the depth of the hole under the lake (No. 1), but did occur for the full depth of each of the three other holes. Initial ground temperature measurements suggest that the permafrost is about 250 ft. thick at the location 130 ft. from the lake and about 300 ft. thick at a distance of 550 ft. from the lake.

Probing showed that the permafrost table extended out from shore under the lake and sloped down steeply. 10 ft. from the shore the permafrost table occurred 15.5 ft. below the ice surface; 12 ft. from the shore at a depth of 19.7 ft.; at 15 ft. it was more than 22 ft. below the ice. Although the soils encountered in the three holes adjacent to the lake (Nos. 2, 3 and 4) were solidly frozen, little ice was observed in the soils below the 20-ft. depth. Although flooding of the lake and surrounding area probably does not occur each year, it appears that it may occur at intervals of a few years. Marks on tree trunks indicate an extreme high-water mark about 5 ft. above the present ground surface at the lake, that is, about 20 ft. above the winter ice-level of a nearby delta channel.

G. H. JOHNSTON
R. J. E. BROWN

Northern Research Group,
Soil Mechanics Section,
Division of Building Research,
National Research Council, Ottawa.

METEOROLOGY

Size Distribution of Raindrops

A. C. BEST¹ has found an empirical formula for the size distribution of raindrops. If $F(x)$ is the fraction of liquid water in the air comprised by drops of diameter less than x :

$$F = 1 - \exp[-(x/a)^n]$$

where a and n are constants for any particular rainfall. Contrary to the general supposition that the above formula applies to the average size distribution of a number of samples of rain, I have found that the formula holds for individual samples in 90 out of 104 cases of general monsoon rains and in 134 out of 169 cases of thunderstorm rains recorded at Poona, provided the samples are sufficiently representative. The formula fails where the liquid water distribution is multimodal (generally bimodal) or where the distribution curve has a long tail with a sharp maximum either at the beginning or at the end.

The parameters a and n are found to be independent for general rains but are connected by the average relation $an = 7.1$ mm. for thunderstorm rains. There is also a correlation between the intensity of precipitation I (mm./hr.) and the parameter n . For general rains the average relation found is:

$$I = 6.9 \exp[-0.14(n - 5.5)^2]$$

and that for thunderstorm rains is $I = 975 \exp(-n)$.

V. N. KELKAR

Nowrosjee Wadia College,
Poona, India.

¹ Best, A. C., *Quart. J. Roy. Met. Soc.*, **76**, 16 (1950); **77**, 418 (1951).

PHYSICS

Stark Broadening of the Spectrum Line 4603 Å. of Lithium

THE Stark broadening of spectrum lines, in particular the lines of hydrogen, has been of interest to astrophysicists for many years. Recent advances in plasma physics on a laboratory scale have emphasized the need for a better understanding of the relationship between the number density of charged particles in a plasma and the profiles of the spectrum lines from the plasma. The broadened hydrogen lines from a water-stabilized carbon arc have been studied carefully by workers at Kiel¹⁻³, and the latest refinements of the theory of line broadening describe the profile of H β quite accurately⁴.

The shock tube is a very useful device for studying spectrum lines from plasmas, since the degree of ionization and the temperature behind the shock wave can be varied over a wide range and calculated from measurements of the shock speed. The shock tube used for the present work has a low-pressure section 18 ft. 7 in. long, and a high-pressure section 3 ft. long. Argon is used as the test gas in the low-pressure channel, and hydrogen as the driver gas in the high-pressure section. Diaphragms of aluminium or 'Mylar' are used, depending on the bursting pressure desired. Spectra are obtained with a Raman glass spectrograph. Spectra can be resolved in time by sweeping the spectrograph slit with a rotating disk having a number of radial slots.

Lithium was chosen for initial Stark broadening studies, since this shows a large Stark effect for some of its lines, particularly the line at 4603 Å. Hydrogen and helium both have large Stark shifts, but were not used since their presence in quantities large enough to give easily photographed spectrum lines would reduce the shock strength quite markedly. The lithium was introduced into the shock tube in the form of lithium chloride which was supported on a short rod mounted on the closed end of the tube. A time-resolved spectrum showed that the lithium was excited behind the shock wave reflected from the closed end of the tube. A time-integrated spectrum is shown in Fig. 1. The argon lines are broader than those emitted from an argon discharge lamp and they are also shifted a little to the red. H β appears very faintly; this is excited near the contact surface between the hydrogen driver and the argon. The lithium line at 4603 Å. is very broad. The blackening profile of this line is shown in Fig. 2.

In the analysis of this line it has been assumed that the line is broadened solely by the statistical micro-fields due to ions. The broadening of the lithium line at 4603 Å. has been treated approximately by Holstmark using some experimental results obtained by Stark on sparks through lithium vapour⁵. Since then, more accurate Stark results have become available for lithium mainly through the experimental work of Poirot and these results have been used for the present analysis⁶.

The lithium line at 4603 Å. arises from a $2p-4d$ transition. Under the action of a uniform electric field this line is displaced to longer wave-lengths and two other lines appear, one due to a $2p-4p$ transition and the other to a $2p-4f$ transition. The $2p-4p$ transition gives a weak line at 4636 Å. for vanishingly weak electric fields, shifting to longer wave-lengths at increasing field strengths.