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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

A PRELIMINARY REPORT ON
A TRANSMISSION FLUORIMETER

by

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In the measurement of the fluorescence of solids, it is the general practice to measure the fluorescent light emitted by the same surface which is irridated with the exciting light. The light source and the phototube are ordinarily set at angles of 45° or 90° with respect to each other. Typical arrangements are those used in the Oak Ridge Model R Fluorimeter (fig. 1) and the U. S. Geological Survey modification (fig. 2). These drawings show that neither the lamp nor the phototube can be brought closer to the sample without one obstructing the light path of the other. However, greater sensitivity would result if these distances could be decreased.

In a general discussion of the principles and methods involved in the measurement of fluorescence of the fluoride melts obtained in the determination of uranium, Morris Slavin of the Trace Elements Unit suggested the possibility of transmission measurements of fluorescence. Preliminary visual and spectroscopic tests indicated that the melts were sufficiently translucent to the fluorescent light to warrant further investigation of this method of measurement.

In a transmission instrument the lamp and phototube would be on opposite sides of the sample. Such an arrangement permits the closest possible approach of the lamp and phototube to the sample. In addition to the increased sensitivity to be expected from this arrangement, its compactness would have the further advantage of greatly reducing the amount of stray light striking the phototube. This would permit the accurate measurement of very weak fluorescence.

A simple instrument was designed to further test the transmission method. This instrument is shown schematically in figure 3. An EH-4 lamp was used as an exciting light and the Photovolt Electronic Photometer (Model 512) as the measuring unit. Standards containing from 0 to 0.15 micrograms of uranium were fused on platinum crucible lids with 1.5 g of flux and then read on the new instrument. The sensitivity was so high that even with about 90% of the glass standard (from the Oak Ridge Model R Fluorimeter) masked off it was still possible to obtain an instrument reading of 1000 for the glass.

The results obtained for these standards are shown in figure 4, curve A. Comparison curves for similar standards obtained with the Survey Fluorimeter and with the Model R instrument are given by curves B and C respectively. These curves clearly show the great increase in sensitivity possible with the new instrument.

The high sensitivity of this instrument should permit the determination with high precision of much less than 0.003 micrograms of uranium in 1.5 g of flux. The sensitivity given by Price (1) for his instrument without cooling the phototube was 0.009 micrograms of uranium in 200 mg of flux. This sensitivity will permit the use of much smaller samples of aliquots with a subsequent simplification of the chemical and manipulative procedures. It also raises the possibility of determining the uranium content of single small grains of uranium ores.

(1) Price, G. R., Ferretti, R. J., Schwartz, S., The micro-fluorimetric determination of uranium: Met. Lab. cc-2985, June 1945.

Further investigations are being planned to ascertain the absorption characteristics of the melts with respect to the exciting light and fluorescent light, the best size and shape of the melts, and factors affecting the reproducibility of the measurements.

It is also believed that a similar instrument would be ideal for use with liquid samples. It would allow the measurement of a large uniformly fluorescent surface with a small volume of liquid, thus eliminating the effects of the absorption of the ultraviolet and fluorescent light which generally occur when large volumes are used.

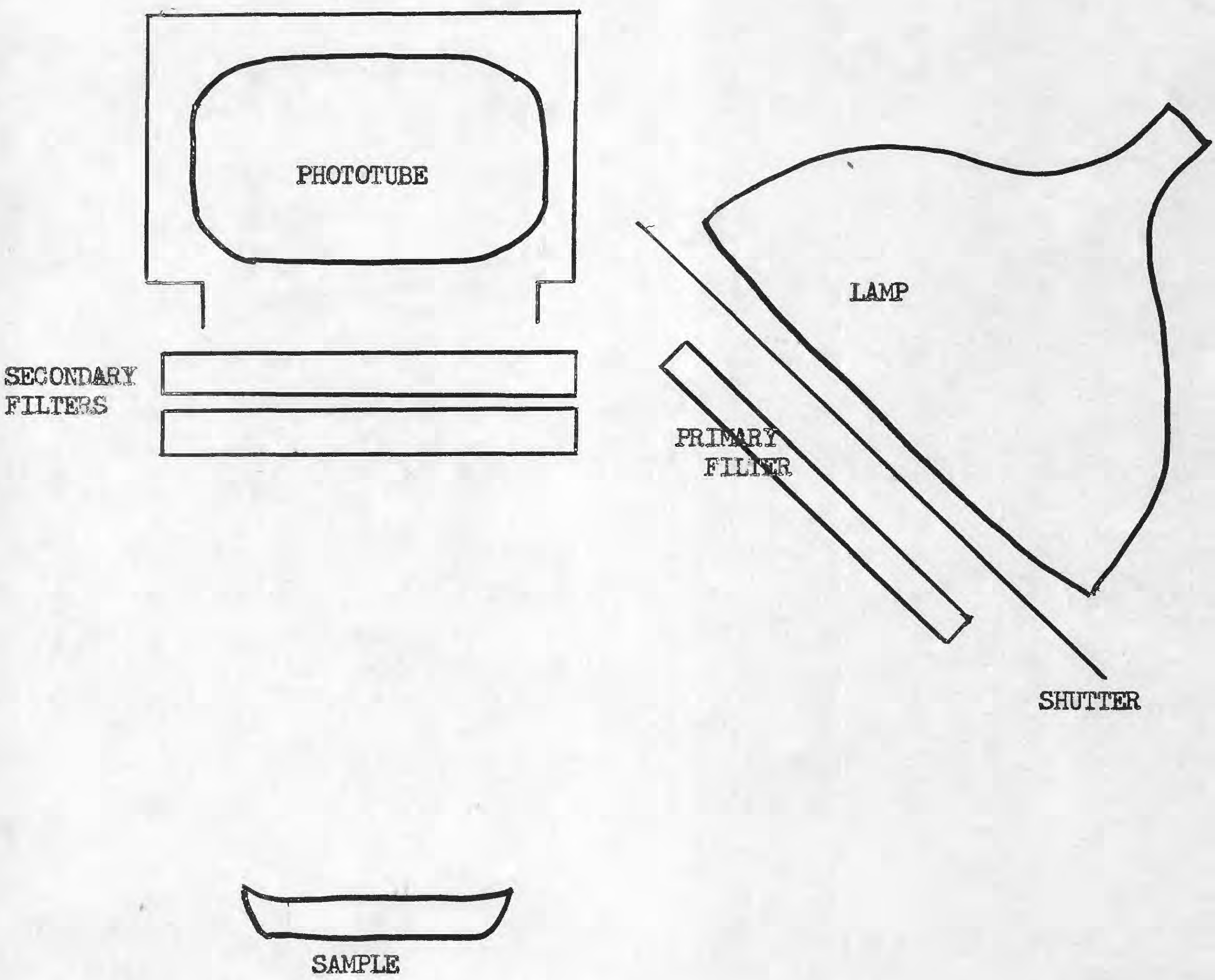

Figure 1. Schematic diagram of the Oak Ridge Model R fluorimeter.

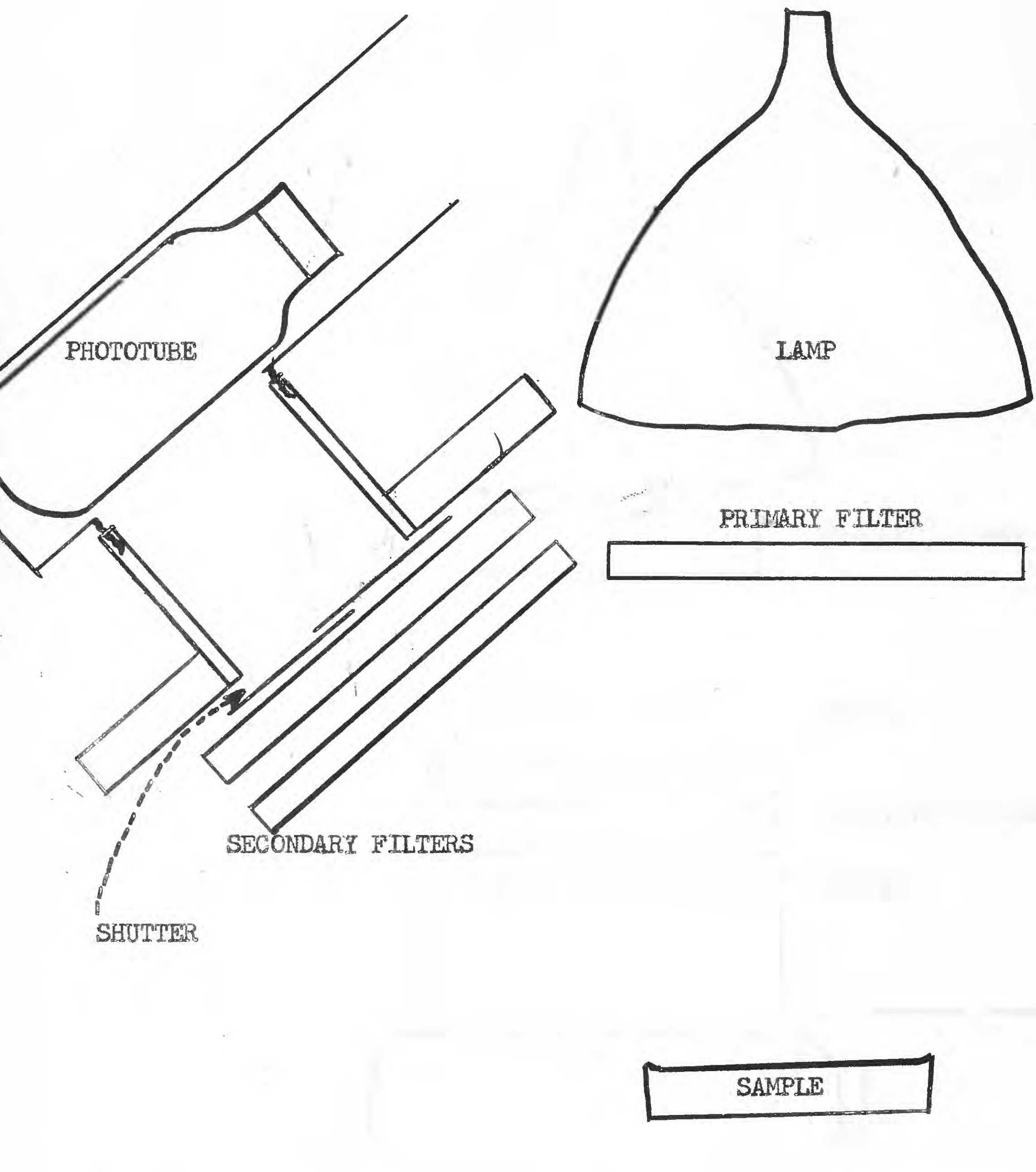

Figure 2. Schematic diagram of the U. S. Geological Survey modification of the Model R fluorimeter.

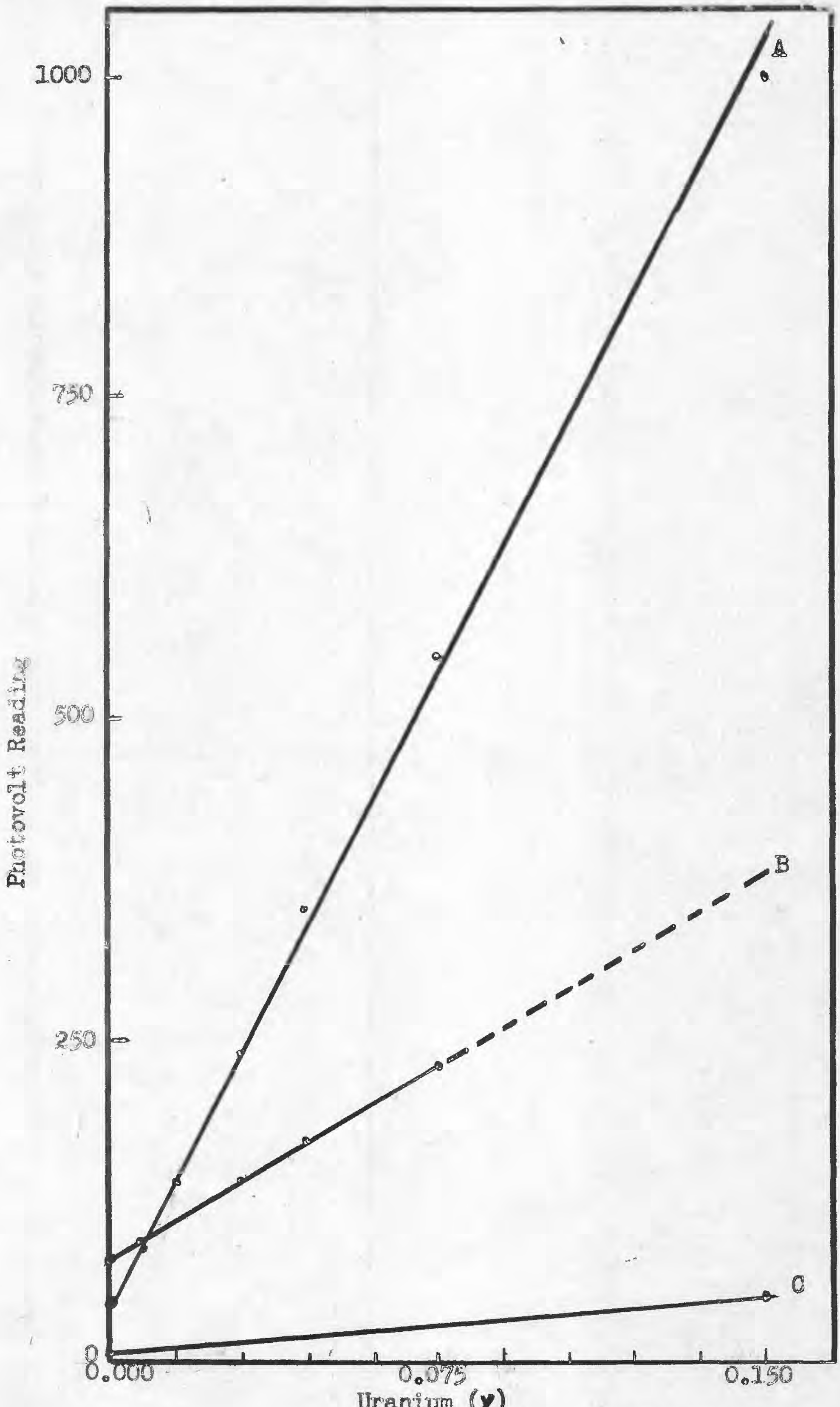

Figure 4. (See text)