THE EFFECT OF PHOTO-ELECTRIC CELL TEMPERATURE ON FLAME PHOTOMETER DETERMINATIONS

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Flame photometers are being more and more widely used for the measurement of sodium and potassium concentrations in blood and other biological fluids. A number of papers have been published describing various types of instrument and the factors which affect their performance (Berry, Chappell, and Barnes, 1946; Domingo and Klyne, 1949; Hald, 1947; Hospadaruk, Frankenberg, and Neufeld, 1951; Natelson, 1950; Proehl and Nelson, 1950; Spencer, 1950; Weichselbaum, 1949), but few of them (Boon, 1945; Fox, 1951; Hald, 1951; Ryssing, 1951; Spencer, 1950) mention the fact that heating the photocells is an important factor influencing the results obtained. It is therefore considered that attention should be directed again to the "heating effect."

The photometer on which this effect was investigated is a modification of that described by Domingo and Klyne (1949). A "megatron" 45 mm. selenium cell replaces the gas-filled caesium cathode cell for the determination of potassium, and the photocells are incorporated in the side-arms of the chimney in order to make the instrument more compact; in spite of the distance of the photocells from the burner (8 in.) they become heated and produce less current. This is particularly important when potassium determinations are being made, since the photocell used for potassium responds less rapidly than the cell used on the sodium side and the duration of one potassium determination is about three times that of a sodium estimation. Proehl and Nelson (1950) found the determination of potassium more difficult than that of sodium on account of fluctuations. When the standard solutions are put through after the unknown, abnormally low readings are obtained for them and the concentration of sodium or potassium is too high. Conversely, if the unknown is put through after the standard solutions the concentration is found to be too low.

By fixing a thermometer to the outside of the photocell carrier it has been possible to demonstrate the relation between variations in the temperature

and the galvanometer readings. The following results refer to a standard solution containing 2.5 mg. of sodium per 100 ml., but similar results are obtained with potassium solutions. Without heat insulation between the cell carrier and the rest of the side-arm the galvanometer readings remain steady for only the first few minutes after lighting,

TABLE
DIFFERENT RESULTS OBTAINED WHEN AN UNKNOWN SOLUTION (DILUTED SERUM) IS PUT THROUGH BEFORE AND AFTER THE APPROPRIATE STANDARD SOLUTIONS*

Solution Sprayed	Ga'lvo. Reading	Concentration Calculated for Unknown Serum
X Serum, diluted 1/10	11.3	17.4 mg. K% 16.7 mg. K%
↓ Standard, 2.0 mg. K%	13.5	
↓ Standard, 1.5 mg. K%	9.2	
Y Serum	10.7	17.7 mg. K% 16.8 mg. K%
X Serum	10.3	
↓ Standard, 2.0 mg. K%	12.2	
↓ Standard, 1.5 mg. K%	8.0	
Y Serum	9.5	

*One series of readings taken between 10 and 20 minutes after lighting, without heat insulation. Approximately 2 minutes elapsed between the reading marked X and Y in each group. The serum had a potassium content of 18.0 mg.% determined chemically.

FIG. 1.—Photocell incorporated in the side-arm without heat insulation. For key, see next page.