DISCUSSION

S. Mrozowski, *University of Chicago:* In the process of working here with the 30-foot grating spectrograph we encountered several difficulties directly connected with the problem of secondary standards. It seems possible in principle to obtain an accuracy of ± 0.0005A relative to secondary standards in measurements with such a spectrograph (300,000 resolving power and dispersion of 0.4A/mm in the second order). But with the secondary standards available at present a much lower accuracy is actually obtained. Careful recent measurements of the arc spectrum of bismuth and the application of the combination principle have shown that the wave-lengths obtained are not more accurate than ± 0.002A (in some cases even less), the accuracy being of the same order of magnitude as that found in working with 21-foot gratings. The reason for the low accuracy is the scarcity of secondary standards, which makes it impossible to find the deviation from linearity in the dispersion curve with a sufficient degree of precision. The problem of these corrections has been studied by the author in detail in a paper on the band spectrum of CO_2^+.[1]

The only way to increase the accuracy would be to have at one's disposal more secondary standard lines evenly distributed over the whole spectrum (every 3–4A). The standard iron arc source in air not only fails to fulfill these last requirements, but also gives lines which are much too wide for our purpose. A new standard source should be developed, possibly a water-cooled hollow cathode discharge tube of a simple design containing a heavy substance rich in lines without hyperfine structure. The wave-lengths should be determined interferometrically, but with the interferometer placed in vacuum.

As recent investigations have shown, there is a considerable uncertainty about the value of the refraction index of air. The older values of Meggers and Peters have been shown by several investigators to be a little too low in the visible.[2] Most of the newer formulas proposed, when extrapolated to the ultraviolet below 2500A, give for the vacuum wave numbers values considerably (0.3 cm^{-1} at 2000A) higher than those of the Meggers and Peters formula, which was used in the preparation of Kayser's wave number tables.

Several months ago Dr. Meggers kindly pointed out to me that in his opinion there is no reason to replace his and Dr. Peters' formula in this region by the new ones, and I must say with pleasure that I was able to check his statement in the case of the arc spectrum of Bi. The wave numbers obtained for the lines around 2200–2300A agree much better with those on the basis of Kayser's tables than with those obtained by the use of any of the formulas for the index of refraction of air having a considerably smaller coefficient c of the term in λ^{-4}. All these uncertainties about the dependence of the refraction coefficient of air on wave-length should be removed by performing the measurements of secondary standards in vacuum. As the only possible source of uncertainty would be left the value of the refraction index of air for the wave-length of the primary standard. For all the reasons mentioned above, the initiative of Dr. Williams seems to me of great importance. Such work should be extended, but instead of iron another substance should be used, or added to the iron to provide for the necessary density of standards. The performance of the interferometric measurements of such a large number of lines presents a terrific task, but it seems to me to be a necessary step in the development of spectroscopy. For the analysis of very complicated atomic and molecular spectra, such high accuracy of wave-length measurements seems to be indispensable.

[1] S. Mrozowski, Phys. Rev. **60**, 730 (1941).

[2] See the discussion also by R. T. Birge, Phys. Rev. **60**, 766 (1941).