PAPERS COMMUNICATED

**74. On a Method of Standardization of a 25 m.
Jäderin Wire in Terms of the Wavelength
of the Cadmium Red Line.**

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Principle of the method is the same as those described in our previous¹⁾ paper, but the method is much simplified.

Principle of multiplication of the length of an interferential standard. The length of an interferential standard, the wave number of which could be measured by the direct observation, is necessarily limited. To measure the wave number for a longer standard, therefore, that for a shorter one should be multiplied by some method. Fabry and Perot adopted Brewster's white fringe²⁾ or tilting of a standard.³⁾ The former method can not be used beyond triplication on account of disturbance from useless rays, while the latter fails for a long standard over 50 cm. or so. We have improved the former one by cleaning off the useless rays. In the annexed figure, A, B, A' and B' represent the reflecting surface of the two standards, of which the latter has double the length of the former, each surface being kept parallel to the other. Each reflecting surface is divided into three horizontal strips, which are silvered differently as regards the density. In the figure, heavy lines represent the densely silvered portion, dotted lines thinly

Fig. 1.

1) Watanabe a. Masaki: Proc. 3 (1927), 485.

2) Benoit, Fabry et Perot: Travaux et Mémoires du Bureau international des Poids et Mesures. 15 (1915).

3) Fabry et Buisson: Journal de Physique. 5^e séries, 9 (1919), 189.

silvered, while fine lines show non-silvered portions. White parallel ray from a source S is divided into two parts at a . The first part is reflected at a , b , c and d successively, while the second passes through a and is reflected at a' and d' . Then, both the parts join at d' and travel toward C, where a compensator (lame étalon) is put to measure the difference of their paths. To clear off the useless ray completely, screens Sc and Sc' with slits sl and sl' are placed as shown in the figure. The inclination of the ray should be changed for different times of multiplication.

We have measured the wave number for 6.25 cm. standard directly, and this has been multiplied 400 times to achieve measurement of 25 m. standard, by interposing two standards of 1 m. and 5 m. successively. The multiplication involved therein are 16, 5 and 5 respectively. The available dimensions of the reflecting surfaces are 50 mm. in height and 30 mm. in breadth. The height of the ray for 16-time multiplication is only 3 mm., but this is enough to observe the white fringe. The fringe was very clear. Even in the case of comparison of 5 m. and 25 m. standards, $1/20$ of a half wave length is easily measurable, and five fringes of higher orders—i.e., the fringes corresponding to $1/2$, $1/3$ $1/6$ of the difference of the paths—were visible under good condition of air. It seems possible to apply this method to a case of some hundred meters without much difficulty.

Owing to the perturbation of air, the white fringe moved to and fro in the compensator, especially during the comparison of 5 m.-25 m. standards; but it returned to a certain nearly fixed position within a few seconds. This to-and-fro motion was reduced to 10 or 15 half wave-length by guarding the path of the ray with a pipe made of a thin sheet iron.

The white fringe in the compensator shows simply the difference of the paths. To determine which path is the longer, a thin mica plate was placed at P or Q. If the fringe displaces to larger difference by putting it at P, the standard AB is longer than a half of A'B', and vice versâ. By the amount of displacement of the fringe, its order may be decided, if the thickness of the mica plate is determined previously.

Y. Väisälä¹⁾ made some experiments by a similar method of duplication of 3 m. and over, utilizing the diffraction of light.

Construction of interferential standards. 6.25 cm. and 1 m. standards were those used also in the previous determination. Each glass plate

1) Y. Väisälä.; Veröffentl. des Finn. Geodat. Int. Helsinki. (1923), Zeit. des Instrumentkunde. (1927), 398.

for 5 m. and 25 m. standards was fixed on a U-shaped brass plate, which had been cemented on a concrete pillar erected at the presumed position. Silvering was made very dense for the sake of multiple reflections, especially for the 6.25 cm. standard. Determination of blue and violet rings of cadmium ray was a little hard, and the method of coincidence was thought somewhat doubtful. So, for checking the coincidence, a standard of half the length (3.125 cm. ca.) with lightly silvered glasses was compared by means of the white fringe according to our method of comparison.

For comparison of 25 m. standard and Jäderin's wire, a portion of concrete pillars for the 25 m. standard was made hollow below the glass plates, to pass Jäderin's wire through. An ocular micrometer of 0.1 mm. division and a plano-convex lens were attached with Canada-balsam on the upper and lower surfaces respectively of the glass plate as shown in Fig. 2. The lens gives real images of the micrometer divisions about 8 cm. below the lens. These images served as reference lines, and divisions of scale of Jäderin's wire were brought into coincidence with these images in case of comparison. The distances between these images and the reflecting surface were determined previously.

For compactness' sake, the standards were disposed side by side instead of placing them in a straight line. The white ray was sent to the second one from the first after reflections on two plane mirrors. Parallelism of the standards was adjusted by turning the mirrors.

General procedure of standardization. Standardization begun with measurement of the diameters of red, green and blue rings of cadmium ray produced by a lamp of Michelson's type for the 6.25 cm. standard. Comparisons of 6.25 cm.-1 m., 1 m.-5 m., and 5 m.-25 m. standards and micrometer reading of Jäderin's wire then followed. The same operations were repeated in the reverse order. The whole course of observation might be completed in 25 minutes after some practice. Wave

Fig. 2.

number for 25 m. standard under standard conditions was obtained easily from the observed data adding corrections due to temperature, pressure, humidity and carbon dioxide gas content around the 6.25 cm. standard, and also corrections due to difference of temperatures around the 6.25 cm. and 25 m. standards. Adding the constant A and the micrometer readings of Jäderin's wire to this number, the length of Jäderin wire was obtained.

Conclusion. Length of 25 m. was measured in terms of the wavelength of the cadmium red line in a short time by a simple method. This method may be extended to the case of a few hundred meters without much difficulty. Any small variation of the length can be traced from time to time by following up the positions of white fringe in a compensator. Thus, the method may find an application in tracing the deformation of the earth crust, and problems of similar nature.

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