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We published about 2 years ago[1] a description of the double-chamber compensation water-flow pyrheliometer No. 5 and the results of comparisons made between it and silver-disk pyrheliometer S.I.5_{bis}. These results indicated that the Smithsonian radiation scale of 1913 was 2.5 percent too high, but on account of certain defects in the sensitive parts of the water-flow pyrheliometer No. 5 we felt that further comparisons were needed before accepting that correction.

The thermoelectric junctions, which were imperfectly soldered in 1932, have been removed and replaced by others securely melted together. Every care was used in reassembling the instrument to guard against all conceivable sources of error. We have employed the instrument on Mount Wilson in July 1934 to restandardize silver-disk pyrheliometer S.I.5_{bis}. Besides the diaphragms within the boxed instrument shown in plate 1, figure 3 of our former publication, we invariably used in addition in 1934 the double polished screen described in lines 34-40, page 4, of our former publication, whereby the water-flow pyrheliometer No. 5 was limited to observe precisely the same sky area as the silver-disk pyrheliometer S.I.5_{bis}. All other arrangements were precisely like the best ones described in our former paper. During most of the days observed in 1934 the sky was of exceptional clearness, and observations were made only at high sun. The temperature of the different days varied so much that on some comparisons silver-disk pyrheliometer S.I.5_{bis} was read at 46° C., while on some other occasions its readings were as low as 26°, with all intermediate temperatures between these extremes represented in the several series. We were unable to detect any differences in results showing any influence of this large range in temperatures.

As stated in our former paper, the entire measurement made with the compensation water-flow instrument consists in a determination of the energy of the compensating electric current. Equivalence between solar and electric heating in the two opposed chambers is indicated by

[1] Smithsonian Misc. Coll., vol. 87, no. 15, 1932.

a null reading of the sensitive galvanometer connected into the thermoelectric circuit whose two sensitive junctions are in the outflowing currents of water issuing from the two chambers. In preparing for a series of readings, both chambers were opened simultaneously to the sun rays, and the adopted zero of the galvanometer was that which subsisted during this preliminary joint exposure. After the conclusion of a series, the zero was again determined in the same way, and sometimes was found to have changed a little. Nevertheless, error from such a drift of zero is approximately eliminated by the device of alternately exposing the two chambers to solar and electrical heat. For if owing to an unknown drift of the real zero the electrical energy is determined too large within one chamber, it will be found for the same reason too small in the other immediately afterward by about an equal amount. To secure complete elimination, we took one more electrical measurement on one side than on the other and made our comparisons as between $\frac{\text{West plus West}}{2}$ and East. Users of the Ångström compensation pyrheliometer will have employed and will appreciate this corrective principle. In fact we found no appreciable difference in the results of the various series as between occasions when the drift of the galvanometer zero was relatively large and relatively small, respectively.

The total deflection for uncompensated solar heating ranged from 3 to 10 centimeters on the scale of the galvanometer, depending on the rate of flow of the water current used on different days. The zero observation could be made to a tenth of a millimeter or better, corresponding to from $\frac{1}{300}$ to $\frac{1}{1000}$ of the total deflection. No systematic difference in results depending on the rate of flow of the water current could be detected.

During the entire campaign of comparisons, the silver-disk pyrheliometer was read by C. G. Abbot, with timing by the eye and ear method, listening to beats electrically sounded from an accurate seconds pendulum. The galvanometer and current measurements were made by L. B. Aldrich.

To determine the electrical energy of compensation, an electric current from storage batteries was passed through slide wire resistances, thence to a milliammeter, and thence to the manganin heating coils within the pyrheliometer chambers. The resistances of these heating coils were repeatedly measured on a standard Wheatstone's bridge. They were found to be identical to within less than $\frac{1}{1000}$ with the resistances of the same coils in 1932. The readings of current on the milliammeter ranged between 50.0 and 63.0 on its scale, and could usually be read to somewhat better than $\frac{1}{600}$, possibly to $\frac{1}{1000}$.

The milliammeter, with its position and surroundings unchanged, was calibrated against two standard cells which were obligingly checked against standards between two of our comparisons by a member of the staff of the California Institute of Technology, and found highly accurate. We believe that we have measured the pyrheliometer currents by these methods to better than $\frac{1}{500}$, possibly to $\frac{1}{1000}$. As the current enters the formula in its square, the error due to inaccuracy of current measurements may reach 0.5 percent but is believed to be less. Accidental errors of the standardization of silver-disk pyrheliometer S.I.5_{bis} against the water-flow pyrheliometer are to a great extent eliminated by the numerous repetitions of the comparisons.

We now give in the following table a summary of the results of the standardization.

Date	No. of comparisons	Temperature range of S.I.5_{bis}	Mean value of constant S.I.5_{bis}
1934		° Centigrade	
July 12	5	35-46	0.3667
" 14	6	31-42	0.3641
" 15	6	30-40	0.3626
" 16	5	33-42	0.3615
" 17	11	29-38	0.3622
" 20	9	26-34	0.3619
	Total 42		Mean 0.3629

This mean value is 2.3 percent below the value 0.3715, which, as stated in our former paper, represents the Smithsonian scale of 1913. The defect 2.3 percent is in close agreement with the defect 2.5 percent indicated by our results of 1932. But on account of the numerous observations and highly satisfactory conditions prevailing in 1934, we prefer to attach full weight to the correction 2.3 percent. The causes which may have contributed to the higher scale found in 1913 are fully discussed in our former paper.