

Levelling Observations Across the Bosphorus and Dardanelles

To bring the elevations of both European and Asiatic parts of Turkey to the same datum surface was planned several years ago and carried out first time in the season of 1955.

The main reason not observing them before that year was to wait the completion of the first order levelling lines which will make a loop around the Marmara Sea. The method of observations across both straits was a combination of geometric and trigonometric levelling, similar to that used over the River Mississippi with 1200 m. distance with the exception that the target used in these observations was a little smaller in dimension and also the number of readings in the observation of Bosphorus were double; namely, 400 instead of 200 of Mississippi observation in a single day. The instrument used for this observation was a Wild III and two instruments were used at the same time. To start the observation an instrument and a rod, with two targets of it, is set on each side of the sea. The target used was 25 x 15 cm. in dimension and painted with black and had a horizontal white band 3 cm. wide across the target. In the middle of this band there was a small window and a thin horizontal wire across it to see the graduation of the rod to set the target over the desired elevation.

The principle of this method is, since the instrument cannot see the graduation of the rod on the other side of the water when it levelled, to arrange a system of observation so that the required reading of the rod will be found mathematically by using two targets set on this rod. It is important that the elevation of both instrument and rod will all be about the same and furthermore, the two targets which are not far than a meter distance from each other and set on an even number of the graduation by means of thin wire will be regulated along the rod so that one of them will be above and the other target will be below the horizontal line of the instrument set on the other side of water. All these requirements as well as the regulation of the observation of both instruments are done by means of a small radio instrument set on each side of the river during the observations. After having the instruments ready and the rods set over a bench mark, the observation is regulated with radios, start at the same moment on both sides

of the river. The micrometer of the instrument read then three times, first when the horizontal line of telescope is set on the top target and then when the bubble is in the center and finally when it set on the bottom target and these three readings, regarded as one, is repeated 25 times. To stop the observation at the same moment the observer who observes faster than the other, continues his observation until the other completes his 25 readings which is regulated again as it was mentioned above, by radio.

After reading first the near rod, with instrument levelled, and then the 25 readings of the far rod the observers together with the instruments, and the rod (leaving the tripod on its place) move to the other side of the river and set the instrument and rod again and start the observation as before. At this station read first the 25 readings of far rod. read the near rod with the instrument levelled and then another 25 readings to the far rod. Finally the observer move with his instrument and rod to his first station and repeat the last 25 readings of far rod and the readings of near rod as before. In this way each instrument completes his 100 readings and so the 200 readings of two instruments make a complete set of one day observation. After taking the mean of each day's micrometer readings for top, levelled and bottom target settings the required distance from the bottom target is :

$$\frac{\text{Difference of levelled and bottom readings}}{\text{Difference of top and bottom readings}} \times \text{Distance between targets in meter.}$$

Finally by adding the computed distance to the setting of bottom target we obtain the reading of far rod and by taking again the difference of near and far rod readings we have the elevation difference of the two bench marks set on each side of the river.

In the Bosphorus observation, since the distance was only 860 m. , two complete sets could be done in each day and two days were used for this purpose. It was surprising that although the individual means gave sometimes even 200 mm. differences, the difference of the means of two days do not vary more than 2,7 mm. from each other.

In the Dardanelles where the distance was 1450 m. , 200 readings are made on each day and two observation days are used for this purpose. The difference of individual means varied here as large as 470 mm. , still the mean of two days observation differed only 19.8 mm. which was accepted as satisfactory for the time being.