

and fixed on a strip of lead tacked to the top of a stout peg driven about 2 ft. into the ground, and having its top countersunk two or three inches. All such pegs are protected from injury by carefully covering them until the measurement of the section is completed. As soon as the starting-tripod is fixed ready for measuring, the theodolite is centred over the peg at the forward end of the first measure to be made, the telescope being on the average about 5 ft. above the ground, and the angle of inclination taken to the contact-mark on tripod, whose average height is about 3 ft. 6 in. above the ground, both verniers being read, face right and face left. When the grades are steep eight readings are taken. Immediately the inclinations are booked, the support-stands—50 links apart—are ranged into line, and the spring supports placed on the grade between the horizontal axis of theodolite and contact-mark on the tripod.

In ranging in the support-stands, as the tripod and theodolite are both centred on the base-line itself, but the actual measure to be made is the line between the contact-mark on the tripod-head and the outer end of the axis of the vertical arc of theodolite, which point is 0.372 link from the true base-line, it follows that the support-rods must be placed on a line parallel to the measure being made, and at a distance of about $1\frac{1}{2}$ in. therefrom. That is, the rod of stand (1) in Fig. No. 13 is placed to the left of the optical line AC, so that this line will pass through about the centre of the space between the shaft of the support-stand and the wing of steel support sliding on the rod. Stand No. 2 is placed nearer to the optical line, and so on until stand No. 5 is exactly on the line AC. From this point the stands pass to the right of the optical line, until stand No. 9 is about the same distance to the right of AC as stand No. 1 was to the left.

The operation is perhaps more difficult to understand from description than to perform, as in practice the stands are placed rapidly in their correct positions, and the steel slides run up or down the rods, and placed on the grade-line between B and C.

The corrections for the eccentricity of the line measured are obtained by inspection from a table computed for the purpose.

Tape No. 02 is then lifted and placed on the supports, and it is carefully watched to see that the tape is lying flat, without twists, throughout. The observer at the rear-end tripod then clamps the tape, B end, on to the adjusting-screw of the measuring-stand (A and C, Fig. No. 8), and signals so by whistle, when the tape is at once pulled taut, and clamped to the balance on the tension gear (F, Fig. No. 9, and K, Fig. No. 10). The sliding frame E, Fig. No. 10, carrying a slow-motion screw, is then run up from the bottom of rod A until the required tension is nearly on, when it is made exact by the slow-motion screw. "All ready" is signalled, then the rear contact is made perfect, and the position of the graduation-mark on the A end of tape passing the scale is read, and repeated several times, the tape being lifted from the supports and dropped again between each reading. The last reading of the series booked is made by the tension-adjuster, as a check. Temperature-readings are taken at both ends of the tape, but, as the coefficient of expansion of the Invar (nickel-steel) from which the tapes are made is very small, being, as supplied by the makers, 0.0000016 per degree Fahr., there is no necessity for the same degree of accuracy as is required when steel tapes are used.

Tape No. 02 is then replaced by Tape No. 03, with which another measure is made in the same manner as already described. As soon as completed both tapes are lifted by the four men, and carried forward to the next length to be measured. While the first measurement is being made, one man is erecting the next tripod forward on the line, so as to be ready for the measurement of the second length. In this case the A end of tape is at the tripod, and the B end at the scale, so that alternately throughout the measurements the A and B ends are read at the scale.

One now well-known peculiarity of the nickel-steel tapes (Invar) is their property of contraction with use, especially when new. This difficulty necessitates frequent comparisons, and, as the comparators have to be laid down with a pure-steel tape, it is sometimes difficult to obtain suitable positions in the shade. In some localities it would be imperative to have portable artificial shade, and I think this will have to be provided for in the measurements of some of the other proposed bases. A comparison of the values for the several chain-lengths in column 9, Table No. 3, of the fifth test, there given, with the corresponding values under the sixth test will give an idea of the changes in length which take place. These changes are not at all regular, and for this reason the tests with the standard comparator should be as frequent as possible. If there are facilities for doing so at the end of every mile or thereabout of measurement, then such test should be made if the finest results are desired.

Sections 1 to 4, owing chiefly to the changes in the tape-lengths, were measured six times each, due weight being given to each measure in the final results for the sections. Sections 5 to 9 were measured four times each. The total mileage of the $8\frac{1}{10}$ -mile main base-line measurement, inclusive of all repetitions, is 40 miles 1762 links, and of the auxiliary base (which was measured four times) 5 miles 5855 links, and together 45 miles 7617 links.

As a proposed check on the measurements crossing the four gullies shown on section 9 in Fig. No. 2, direct measurements were made with the tape unsupported throughout, the longest measurement thus taken being 429 links. Although calm weather was taken advantage of for this work, the results are far from being satisfactory, and have been abandoned.

Table No. 1 gives the final results of the measurements.

The length of the base, reduced to sea-level, is 64776.6572 links ± 0.0219 link ($\pm 0.34\mu$), or 1 part in 2,962,000. This length may be subject to slight correction when the length of the steel band has been checked again.

Observations for the probable error in laying down a comparator, as well as specimen pages of field and computation books, are appended.

I have to express my thanks to Mr. C. E. Adams, Chief Computer, Head Office, for the great interest and trouble he has taken in verifying the final results of the measurements, and computing the probable errors attached to each.