

Quite true, it is not absolutely necessary to measure very correctly the distance from the instrument to the rod for such purpose; but it is very important for us to be in a position to exercise such a perfect control over all the rod readings, including those corresponding to the horizontal or fore and back sights, as will enable us to readily correct on the ground, or in the office, by means of the entries in the field book, any error that may be discovered after the removal of the instrument from a station whence an erroneous reading was made.

Now it is only by making the four rod readings required, to establish the length of each one of the three contiguous spaces intercepted by the horizontal wire in the positions of the telescope determined by the four pins or pegs, *a*, *b*, *c*, *d*, or failing which, by making all the rod readings found to be necessary to establish the length of each one of three corresponding spaces which are not all contiguous, that we can manage to secure the desirable perfect control in question, hence the advisability of invariably taking such a set of four or more readings whenever possible.

A little reflection will convince us that all the four readings mentioned are really essential to fully ensure the desired control.

Suppose for a moment, we confine ourselves to three readings, viz., those corresponding to the positions *a*, *b* and *c* of the lever; those readings will give us the intervals $\overline{ab}$, $\overline{bc}$, and $\overline{ac}$ bearing to each other the ratios of the numbers 10, 8 and 18.

Now let us say that instead of the true height *b* corresponding to position *b*, we read by mistake a greater height *B*, we will then have $\overline{aB} > \overline{ab}$ and $\overline{Bc} < \overline{bc}$, while $\overline{ac}$ retains its true value, and hence we have also: $\frac{\overline{aB}}{\overline{Bc}} > \frac{10}{8}$ and $\frac{\overline{ac}}{\overline{aB}} < \frac{18}{8}$.

These inequalities are, no doubt, a sure indication that a mistake has been made somewhere; but they do not supply the means of locating the error. For this purpose a fourth reading, and an additional contiguous interval $\overline{cd}$ are indispensable; this interval will show us which one of the three spaces $\overline{ab}$, $\overline{bc}$, $\overline{ac}$ is right and therefore enable us to detect the wrong reading and correct it.

In the case just supposed, we readily find out that $\overline{cd} > \frac{4}{8} \overline{Bc}$ and $\overline{cd} < \frac{4}{10} \overline{aB}$; but that $\overline{ac} = 4.5$ or very nearly so, which is as it should turn out, whence we necessarily conclude that readings *a* and *c* are right and that reading *B* is wrong, viz., too large. As will be shown further on, however, when two lines of precise levels are run simultaneously, or which is the same thing when a line of such levels is double rodged, more expeditious means of verifying and controlling rod pointings and readings are available than by taking supplementary readings as above explained—and in order to save time, can be taken advantage of when accuracy in the measurement of horizontal distances is only of secondary importance.

Now, when a tachometer is more especially intended for use as a levelling instrument, as is the case with No. 115, the horizontal fore and back sight readings are always the most important of the whole series, and the intervals to be intercepted on the rod by moving the lever *L* from one of the pins to a higher or a lower one, have necessarily to be reckoned on either side from the intersection of a hori-