

DIRECTIONS FOR USING
THE
FAVORITE FARM LEVEL

No. 5691

MANUFACTURED BY
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NEW YORK

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Leveling Rod furnished with Favorite Farm Level.

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FAVORITE FARM LEVEL.

Our No. 5691 new Favorite Farm Level is designed to meet the demand for a reliable and durable instrument at a price to bring it within the reach of every Farmer, Landscape Gardener, Builder, Roadmaker, etc., to whom it will prove very useful in draining, ditching and roadwork, and for laying out and terracing parks, gardens, farm lands, etc.

It is sturdy and simple in construction, so that it will remain in adjustment and withstand the wear of daily use for a long period of time without requiring attention.

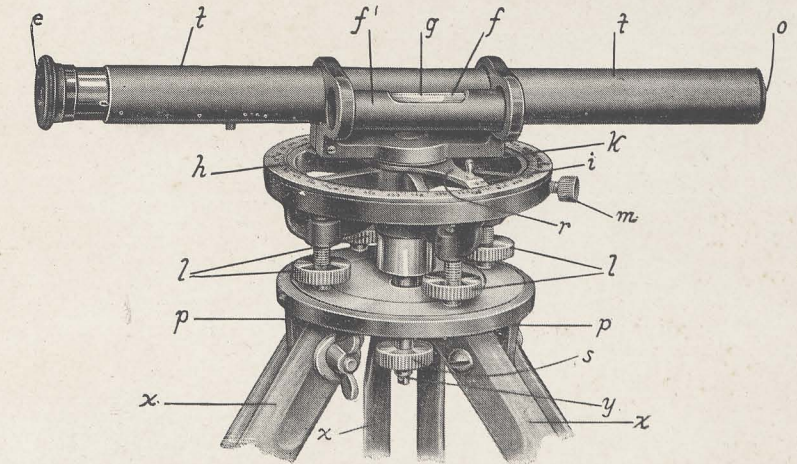
The following description of the instrument and plain directions for its use are free from technical terms and written expressly for those who are not surveyors. By following these instructions, good results can easily be obtained even by those who have had no professional training and who are not familiar with land surveying.

DESCRIPTION OF THE INSTRUMENT.

The telescope, *t*, magnifying about 10 times, is $10\frac{1}{2}$ inches long, with $\frac{5}{8}$ in. object glass, *o*, and with a "terrestrial" eyepiece, *e*.—that is, an eyepiece which causes objects observed through it to be seen in their natural, upright position.

At the side of the telescope is a sensitive spirit level, *f*, $2\frac{1}{2}$ in. long, protected by a strong brass casing, *f'*.

The horizontal circle, *h*, is numbered from 0 to 360 degrees and is divided to single degrees. It is read by the index line, *i*, marked on the arm *r*,



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which can be revolved independent of the telescope, thereby allowing measurements of angles to be repeated, offsets to be made or any angles to be set.

The telescope revolves horizontally on its centre, and can be secured in any position by means of the clamp screw, *m*. The observed object is brought into focus (made clear to the sight) by pulling out or pushing in the eyepiece, *e*. The cross hairs are always in focus.

The instrument is screwed to the base plate, *pp*, by means of the center screw *s*. The eyelet, *y*, at the lower end of the center screw, is for the cord of the plumb bob, which is used to center the level on the desired point.

Four leveling screws, *llll*, serve to level the instrument. When taking the instrument from the tripod, release the four leveling screws before unscrewing the center screw. The tripod is light and strong, and is of the split-leg type.

The extension leveling rod with target (shown in illustration), which is furnished with each instrument, is 5 ft. long, extending to $9\frac{1}{2}$ ft., and is divided to $\frac{1}{4}$ inches; each inch is numbered in black, foot numbers in red. Through the telescope, these $\frac{1}{4}$ inch units are well defined and the figures are easily read up to a distance of 150 feet. Longer "shots" can be taken by utilizing the target, the "rodman" noting the reading. (See Field Signals, page 4.)

DIRECTIONS

For the Use of Favorite Farm Level No. 5691.

This new Farm Level requires no preliminary testing or adjusting. Set up the tripod with its legs spread about $3\frac{1}{2}$ feet apart. Place the level on the

tripod and fasten it by means of the center screw, *s*. Place the tripod so that the telescope, *t*, will be as nearly level as possible, by moving one of the legs, *xxx*, in or out or from side to side. The telescope is then leveled accurately by bringing the "blister" *g*, in the bubble vial, *f*, to the center of its run, by means of the four leveling screws, *llll*.

This is accomplished as follows: Release the clamp screw *m*, revolve the telescope until it is over two diagonally opposite leveling screws. Gripping these two opposite leveling screws between the thumb and fore finger of each hand, bring the blister, *g*, exactly to the center of its run by *simultaneously* slackening the screw under that end of the telescope toward which the blister runs, and tightening the opposite screw. Always loosen and tighten the opposite screws uniformly, turning each the same distance. *Never strain the screws by unequal turning.*

When the telescope is exactly level over two of the leveling screws, swing it around over the other pair of opposite screws and level as before. Repeat this leveling process for each position; usually one repetition will suffice. The telescope will now remain level and the bubble will stay at the center of its run, while the telescope is turned completely around.

To focus the telescope, i. e., to bring the sighted object into clear vision, slowly draw out the eyepiece, *e*, until the object sighted appears clear and distinct. The cross hairs, within the telescope, are always distinct and need no separate focusing.

The level is now ready for work.

FIELD SIGNALS.

When the "rodman" (the man holding the leveling rod) is too far away to hear spoken instructions, signals must be used; and even when within hearing, signals are preferable, as they are less likely to be misunderstood than spoken instructions. The following are the more common signals:

"Right" or "Left". The hand is extended in the direction required—slowly for long distances and quickly for short distances.

"All right". Both hands are extended horizontally and moved up and down

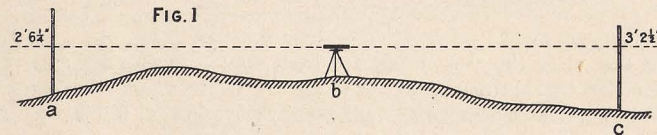
"Plumb the rod" (that is, hold the rod exactly upright). The arm is extended above the head and moved slowly in the required direction, as shown by the vertical cross hair.

"Raise" or "lower" the target. The target is used when the rod is too far away from the instrument to be read. The hand is extended and moved either up or down as required and the rodman slides the target in the direction indicated. For long moves, the hand is raised or lowered a considerable distance; but for short moves, only a slight distance. When the target reaches the point where the horizontal cross hair of the telescope cuts directly through the middle of it (shown by the red and white quadrants), the "All right" signal is given. The rodman then notes the "reading" indicated by the center line of the target.

LEVELING.

Leveling is the determination of the *difference of level* between several points. Set the instrument about midway between the two points of which the

difference of level is to be determined and level the instrument, as explained above. Hold the rod *perpendicular* at one of the two points (called stations) and *read* it through the telescope where the horizontal cross hair seems to cut the graduations on the rod. After noting this reading, place the rod *perpendicular* over the other point (station); without otherwise disturbing the instrument, swing the telescope around to sight the rod in its new position and again read the rod and note the reading. The difference between the two readings will tell how much one station is above or below the other. For instance:

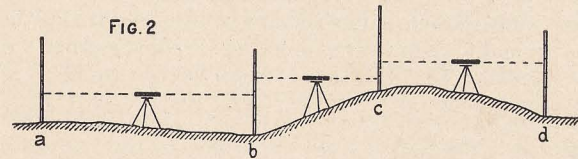


In this diagram the rod is first at station *a*, then at station *c* (*b* being the instrument). If the rod at station *a* reads $2' 6\frac{1}{4}''$ and at *c* it reads $3' 2\frac{1}{2}''$, then station *c* is $8\frac{1}{4}$ inches below station *a*:

Reading at station <i>c</i>	$3' 2\frac{1}{2}''$
" " station <i>a</i>	$2' 6\frac{1}{4}''$
Difference	$8\frac{1}{4}''$

In surveying, the stations are generally indicated by a stake or other suitable object. In sighting several stations on a line, the sights taken in the direction in which the survey proceeds are called *forestations* and those in the

other direction backstations. Long lines are leveled in sections, when the notes may be conveniently taken as follows, the diagram showing the several successive locations of the instrument.



In the notes the rise or fall for each station is entered and the total difference for the entire survey is found by subtracting all rises from all falls, or vice versa, a rise being indicated by + and a fall by—. For the above diagram, the notes would read:

Back sight station	a,	2' 2"	
Fore	"	b, 4' 3½"	— 2' 1½"
Back sight station	b,	5' 10¼"	
Fore	"	c, 1' 4½"	+ 4' 5¾"
Back sight	"	c, 4' 2½"	
Fore	"	d, 5' 3½"	— 1' 1"
Total,		— 3' 2½"	+ 4' 5¾"

Deducting the fall (—) from the rise (+)

Rise,	4' 5¾"
Fall,	3' 2½"
Difference,	1' 3¼" rise,

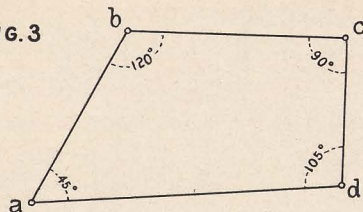
gives a rise of 1' 3¼" for station d, above station a.

For leveling buildings, beams, girders, bridges, etc., the instrument is used without the tripod. The manipulation is the same as when the level is used with its tripod, except that the plumb bob is not used. The support for the level, when used in this manner, say a wall, rock, post, etc., must be approximately level, so that any deviations shall be within the range of correction of the leveling screws, l l l l.

DETERMINING ANGLES.

When the instrument is used for determining angles, the plumb bob has to be attached to eyelet y, below the center screw. The point of the plumb bob will then indicate a point on the ground directly below the center of the instrument and therefore the center point of the angles laid off with the instrument. Angles are read at the reading or index line, i, of the revolving arm r, on the circle h. This circle h is numbered 0—360 degrees. To determine angles requires at least two poles or slats (called ranging poles), one of which may be the rod (used in leveling, as explained above). How to determine angles is most readily explained by an example.

FIG. 3



Required: the angles of plot *a, b, c, d*.

Set the instrument as for leveling at station *a*. Bring it to such a position that the plumb bob, suspended from eyelet *y*, will be exactly over station *a*. Now level exactly as described for leveling. Swing the telescope so that the vertical (perpendicular) cross hair "covers" the rod at station *b*, that is, appears directly in the center of the rod; then clamp the telescope. Turn the revolving arm *r*, by means of the knob *k*, and set the index point *i* to 0 (zero) of the divided circle. Now release clamp screw *m* and revolve the telescope until the vertical cross hair "covers" the rod held at station *d*. Read the horizontal circle at the line on the arm (in this case 45 degrees) and note it.

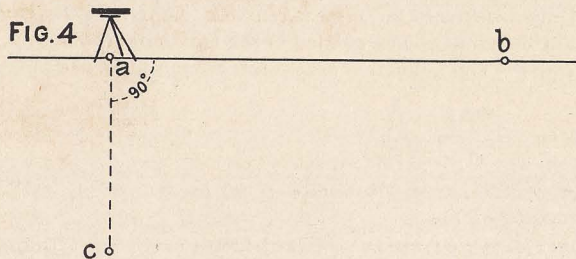
Move the instrument to station *b* and level it there with the plumb bob exactly over station *b*. Cover the rod at station *c* with the vertical cross hair, bring the arm to zero, swing the telescope to cover the rod at station *a* and read 120 degrees. Set the instrument at station *c*, locate the rod at stations *b* and *d*,

proceeding as before, reading 90 degrees. Set the instrument at station *d*, locate the rod at stations *c* and *a*, proceeding as before, and read 105 degrees.

The correctness of these results can now be proved by adding the four angles together, because the sum of the interior angles of a quadrangle is always 360 degrees. In the case of a polygon (a figure with more than four sides), the formula for the sum of angles is $(n-2) \times 180$ degrees (*n* representing the number of sides of the polygon). For instance, a hexagon (six sided figure) gives as sum of the inside angles $(6-2=4) \times 180$ degrees = 720 degrees.

LOCATING ANGLES.

This is the same operation as the determination of an angle already located, except that the *rod is moved* to bring it to cover the vertical cross hair, while in determining angles the telescope was swung around until the cross hair covered the rod.



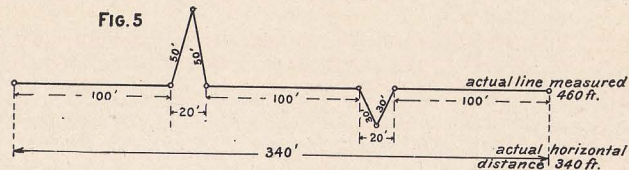
Example: To locate an angle of 90 degrees from a on line a, b .

Set the instrument at station a and *level* it. Swing the telescope to cover the rod at station b and clamp it. Turn the revolving arm r , and set to **O** (zero). Release the telescope and swing it until the index i on the revolving arm r reads 90 degrees, clamp the telescope and have the rod moved to c so that the vertical cross hair covers it. The angle at a (angle $b a c$) will then be exactly 90 degrees.

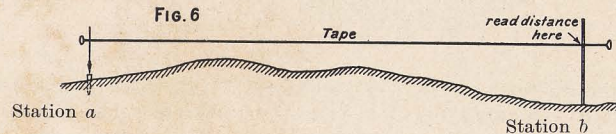
The same method is used when setting off any other angles.

MEASURING.

A few words about the use of a measuring tape will be found of benefit. Ordinarily, a 50 foot steel tape divided in feet and tenths answers the requirements, as it can be used in measuring fairly long lines, as well as for short offsets. All measurements must be taken **on the level** (horizontal); over uneven ground they must be calculated to the horizontal (as is done in professional surveying). The following exaggerated example will demonstrate this.



Measuring the horizontal distance is easily accomplished if it is done while determining the levels. The stations should not be further apart than the length of the measuring tape. When the reading of the rod at the two stations (Fig. 6) is known, attach the plumb bob to the terminal mark of the tape for the station having the lowest reading (in Fig. 6 for station a) and make the length of the plumb bob cord the same as the height read on the rod. Hold the tape, with sufficient pull (tension) to avoid its sagging and so that the plumb bob point will just touch station a (Fig. 6), and bring the other end of the tape to the height of the reading at station b , leaving the rod in position at station b , for that purpose. The tape will then read the correct horizontal distance at the rod at station b .



The following is another simple method for use on sloping or hilly ground. Begin at the top of the hill and measure down hill. Since the horizontal distance is desired, the tape should be held horizontally, plumbing the end of each tape length down on the ground and marking each of these points by iron pins or arrows, and starting anew from each of these points. Note the number of

Note the fractions carefully and add them to the whole tape lengths to obtain the total. In Fig. 7 (which is exaggerated, for the sake of clearness), measurements are taken from point *A* at the top of the slope to point *B* at the foot of the slope, and then from point *C* on the opposite slope back to point *B*.

Measurements 1 to 5 are made with whole tape lengths and measurement 6' with a fractional tape length.

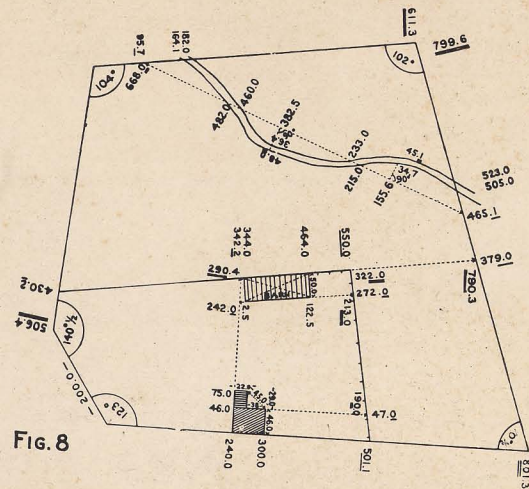


FIG. 8

— 13 —

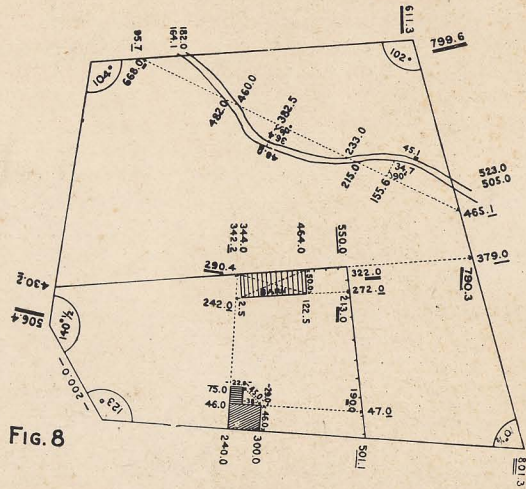
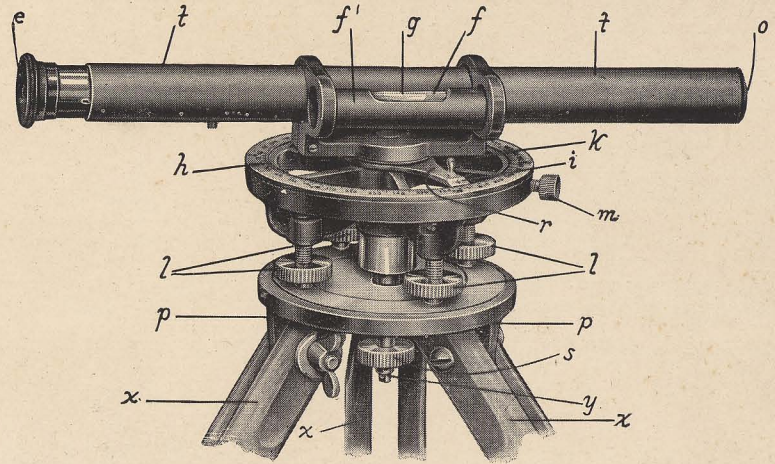


FIG. 8

Fig. 8 illustrates the manner of carrying out and plotting the survey of a farm, showing boundary lines, fences, barn, residence, etc. The dotted lines are auxiliary lines required at the different stages of the survey.





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