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The soil ... our basic asset - A new model hose level

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THE SOIL ... OUR BASIC ASSET



A NEW MODEL HOSE LEVEL

By J. E. WATSON, B.Sc., and B. a'B. MARSH, B.Sc. (Agric.),
Soil Conservation Advisers

FOREWORD

The construction and use of the Hose U-tube Level as designed by Mr. J. P. Fallon was described by him in the Sept.-Oct. 1952 issue of the Journal of Agriculture. Thus he made available to farmers the means of making a simple home-made levelling device which would give accurate and reliable results, enabling them to tackle contour surveying with confidence.

Various improvements have been made to Mr. Fallon's original design and the purpose of this article is to describe the construction and use of the most improved type of hose level.

The first section of this article was written by Mr. J. E. Watson, who did much to incorporate the many suggested improvements on the old level into the efficient and versatile level in its present form.

The second section was written by Mr. B. a'B. Marsh, who has used the level consistently under practical conditions to assess its uses and limitations as a surveying instrument and to work out a convenient method of use.

G. H. BURVILL, Commissioner of Soil Conservation.

At soil conservation schools run by the Soil Conservation Service, many farmers have had the opportunity to try out the "Hose Level" and have been impressed with its simplicity of use and accuracy. A few minutes after seeing the level for the first time farmers have surveyed contour and grade lines, which when tested with the surveyor's dumpy level, have proved remarkably accurate.

A number of farmers have constructed these levels and made good progress in doing the contour surveys required on their farms.

The principle of the hose level is that water contained in two open upright lengths of plastic waterpipe connected by a 60ft length of hose will stand at the same level in both pipes.

The design, construction and details of use of the "Hose Level" depend on a satisfactory method of providing an upright support for each piece of colourless plastic waterpipe, which will allow accurate measurement of the height above the ground to which the surface of the water rises in each pipe.

In the level designed and described by Mr. Fallon, the 4ft. lengths of the colourless plastic pipe are clamped to 6ft. lengths of light wood batten. Movable pointers are attached to each batten or staff. It was recommended that the two sections be joined with $\frac{1}{4}$ in. air-hose to avoid the necessity of repeated adjustment of the pointers, because plastic garden hose is subject to considerable changes in volume in hot weather (it becomes soft and pliable and stretches). To run a contour line, the two battens are held vertically side by side on level ground. The water comes to rest at the same height in each pipe. The pointers are set at this level. One staff is held on point A and the other taken out across the slope to the extent of the connecting hose and moved up or down the slope until the water in the pipes is at the level marked by the pointers. Thus point B is found which is at the same level as point A. By then moving the hose level along and starting from B, a further point, C, can be found which is the same level as B (and as A). By continuing this process, a series of points on the ground sur-

face can be found which are all at the same level. A line joining these points will be a level or contour line.

Much thought has been given to other systems of providing an upright support for the colourless plastic pipe. Various ideas have been tried out and modifications and improvements have been suggested by Soil Conservation Service officers and farmers.

The latest model which has been evolved from these ideas is considered to be more simply constructed and more convenient to use than the original. It allows the use of ordinary $\frac{1}{4}$ in. plastic garden hose instead of the more expensive air hose. Air locks are not so likely in the larger diameter hose. The 6ft. staff is quickly separated into two shorter lengths for transport in a car. All parts should be readily obtainable. A small amount of welding is required.

LIST OF PARTS REQUIRED FOR HOSE U-TUBE LEVEL

- 2-2ft. lengths of $\frac{3}{4}$ in. colourless plastic water pipe.
- 2- $\frac{3}{4}$ in. plastic screw connectors.
- Plastic pipe cementing fluid.
- Small quantity of plumber's hemp.
- 2- $\frac{1}{2}$ in. MF brass adaptors.
- 2- $\frac{1}{2}$ in. leather washers.
- 2- $\frac{1}{2}$ in. MF brass low pressure range cocks.
- 1- $\frac{1}{2}$ in. Copper connection (to be cut in halves to provide a section for each staff.)
- 2-7in. lengths of 1in. brass tube.
- 2- $\frac{3}{8}$ in. x $1\frac{1}{4}$ in. split pins.
- 2- $\frac{1}{2}$ in. plastic hose clips.
- 2-4ft. lengths of $\frac{3}{4}$ in. wooden dowel.
- 1-60ft. length of flexible $\frac{1}{2}$ in. plastic garden hose. Some brands are more flexible than others in cold weather.

POINTS ABOUT THE METHOD OF CONSTRUCTION

The plastic pipe is often curved as it is usually in coils in the shop. To straighten, put a cork in one end, fill the pipe with boiling water and then put a cork in the other end. This will soften the tube and it can then be straightened.

The cementing fluid is necessary to fix the plastic screw connector to the end of the plastic pipe. It is also advisable to use

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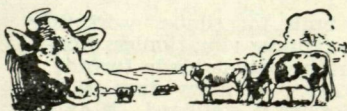
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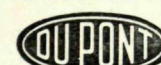
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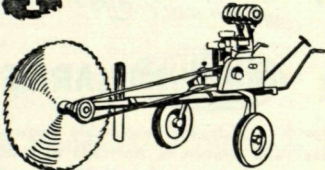


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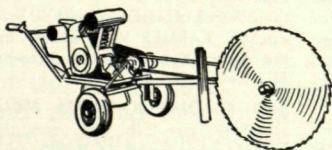
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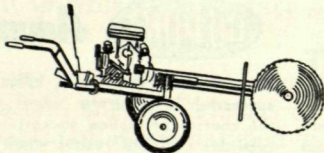
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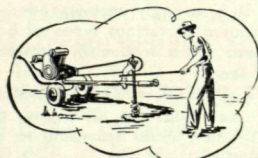
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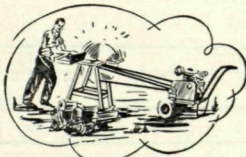
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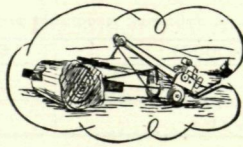
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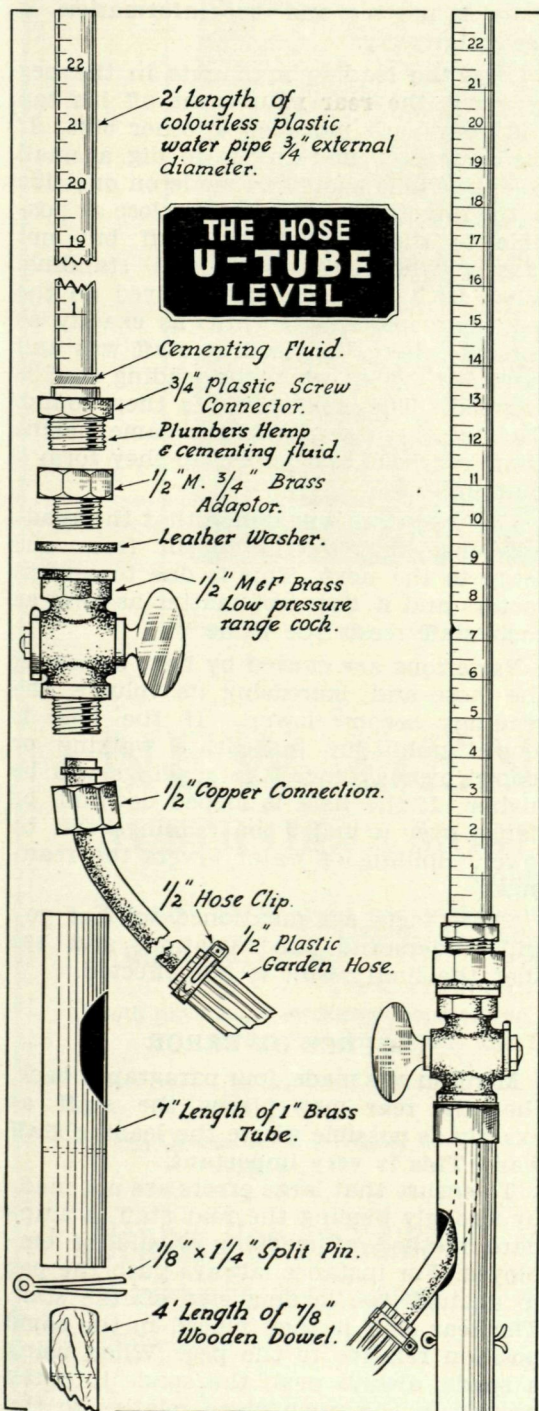
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the cementing fluid and plumber's hemp to make a watertight joint when the brass adaptor is screwed on to the plastic connector.



The plastic pipes are graduated in inches (with halves and quarters marked also). Neat circular markings can be made by tightening a hose clip on the tube and then scratching around the top of it with a sharp instrument or small file. The numbers required can also be scratched on. If the scratches are filled in with black Indian ink, they can be easily seen.

The copper connection is sawn in halves and each half connected to a brass tap. (It may be necessary to use fibre or copper washers to ensure a watertight joint).

A hole is cut in the side of the brass tubing so that the copper tubing (when suitably curved) can be passed in one end of the tube and out through the hole in the side. This is then welded in position.

The wooden dowel is pushed into the open end of the brass tubing. An $\frac{1}{8}$ in. hole is then drilled through the tube and dowel and the split pin inserted.

When the whole staff is assembled, the dowel is sawn off to the required length (the zero marking on the colourless plastic pipe can be made to be either 4ft. 6in. or 5ft. from the ground—it doesn't matter, but both staves must be exactly the same). The dowels should then be graduated with 1ft., 6in. and 3in. markings.

PREPARATIONS FOR USE

Bubbles in a newly filled hose level must be eliminated. Hold the ends of the hose level together with taps open, unroll the loop of hose downhill and shake until no more bubbles appear and the two water surfaces stop next to one another. Small bubbles on side of tube do not matter. Make the water level up to 10in to 12in. mark and switch off taps.

Damping the movement of the water is effected by turning one tap partially off. To adjust this, raise one staff about 12in., turn one tap full on and turn the other tap slowly until water level moves steadily but slowly to equilibrium. This tap is always kept in this position while surveying.

PRINCIPLE OF OPERATION

The two ends of the hose level can be held any distance apart up to the limits set by the hose. When the ends are placed on the ground at some distance apart, and the closed tap turned on, the water comes

to equilibrium and reading can be made at each end. The difference between these readings is the difference in level between the two points on the ground where the two ends stand. If one reads 12 $\frac{1}{4}$ in., the other 15 $\frac{3}{4}$ in., the difference of 3 $\frac{1}{2}$ in. indicates that the first staff is 3 $\frac{1}{2}$ in. higher than the other. If this is brought downhill 3 $\frac{1}{2}$ in. to the same level, the water will go up on one and down in the other until they read the same at 14in. (halfway).

SURVEYING AND MARKING CONTOUR LINES

The hose level is used mainly for surveying contour lines. True contour lines are level lines with no gradient. These are surveyed by finding points at the same level every 50ft., marking each point and then joining these points with some sort of scarifier or plough furrow in the ground. The points every 50ft. may be marked by stiff wire pegs (wood is too bulky and difficult to drive in) or with a spade. The marks must be visible from 50ft., so a heap or clod of soil should be made as high as possible. In soil conservation work, such lines are used as guide lines for contour working or marking the position of pasture furrows and absorption banks.

Once the starting point of such a line is decided, a mark is put on the ground and the **rear staff** placed at this point with the tap turned off. The **leading staff** (with tap adjusted for damping) is carried 50ft. (17 to 20 walking paces according to your size. Don't try to pace yards, it is too tiring. Measure 50ft. and see how many normal walking paces it takes you.) This distance is paced roughly across the slope and the staff placed anywhere on the ground. The rear tap is immediately turned on and the water starts moving to its true level. The leading man moves up if the water moves up and vice versa. He moves the staff until his reading is the same as it was before starting the line, the staves may both have read 12in. so he moves until it reads 12in. While doing this, the rear man is **silently** watching the water till it comes back near the 12in. and becomes nearly stationary; it may read 12 $\frac{1}{4}$ in. and he calls this out once. The leading man hears this and knows the true reading must be halfway between the two readings 12in and 12 $\frac{1}{4}$ in. He moves the staff downhill a short distance till he

reads 12 $\frac{1}{4}$ in. and puts in his mark. The rear man does not have to call this out unless the leading man asks for confirmation. The rear man will get a sore throat too easily if he calls out all the time while the water is moving and the information is useless anyway.

Once the leading man puts in the peg or mark, the rear man turns off his tap and they both move on another 50ft. If the system of marking is to dig a small hole, this hole should be made on one side in the direction of the line as close as possible to the foot of the staff, but not exactly where the staff was standing. When both operators have moved on the rear man places the staff as exactly as possible where the leading staff was and turns his tap on when the leading staff is dropped. The next point is then found. Each of these points is the same height above sea level and joined up they form a contour line.

The operators will notice that the readings may vary by $\frac{1}{4}$ in. to $\frac{1}{2}$ in. from one setup to the next. This is due to several factors and it does not matter as long as each staff reads the same.

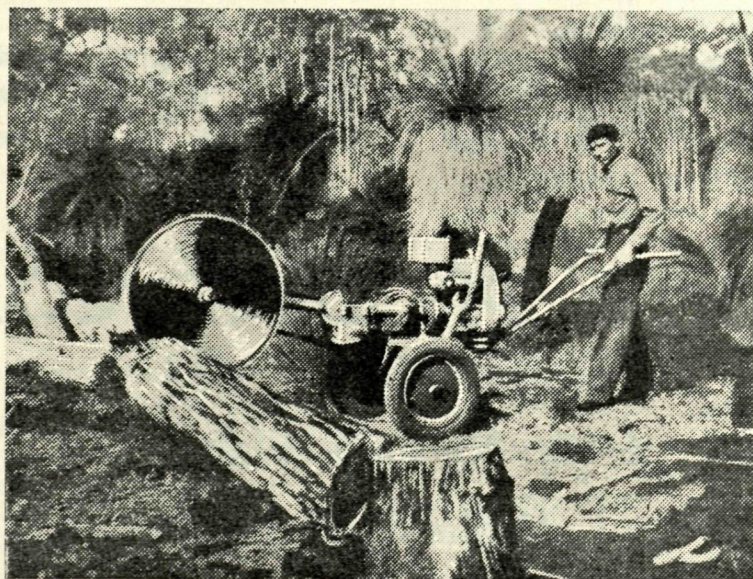
Variations are caused by heat softening the hose and increasing its volume, the readings become lower. If the hose is looped uphill by inaccurate walking or looped over a fence, the readings will be higher. If the hose is looped downhill or hangs over a gully, the readings will be lower. Spilling of water lowers the readings.

These facts are mentioned so that you will understand the variations and see that the final result is not affected.

SOURCE OF ERROR

Mention was made, four paragraphs back, that the rear man places the staff as exactly as possible where the leading staff was. **This is very important.**

To ensure that large errors are not made by wrongly placing the rear staff, a standard method of marking should be employed. For instance, always push the peg in against the leading side of the staff. The rear staff is then placed in the same position relative to the peg. When using a spade, always push the spade into the ground in the same place relative to the



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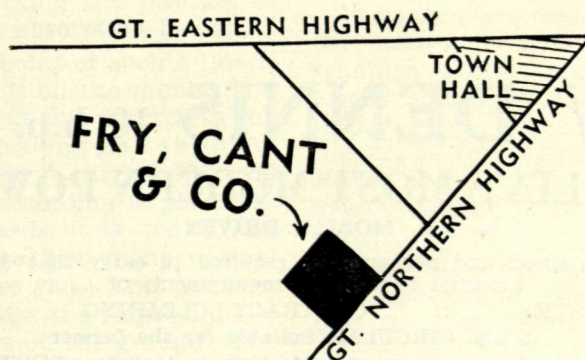
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staff, e.g., with the left hand end of the cut next to the staff, turn the clod out of the hole and leave it so that the tractor driver will see it. The rear man will then place the staff at the same end of the cut.

SURVEYING GRADIENT LINES

In soil conservation works, lines with a slight grade or slope are often required. These are also called contour lines, even though they have a gradient from one end to the other. They mark the positions of banks which are used to take water from unsafe or inconvenient waterways to safe, grassed waterways and also for taking water to dams from other catchments or creeks.

To survey these lines, use the same method as for true contour lines. A little more thought must go into the starting point and keep in mind that the banks should never discharge onto ground used for cultivation, or directly into a gully.

Instead of getting the same reading in each staff, the two readings must differ by the actual amount of the fall. The downhill staff must always read higher. It is still not necessary for the rear man to call out more than once or twice, although more often the leading man does require confirmation of the final reading.

SAFE GRADIENTS

Use this general procedure.

Use grades of $\frac{1}{2}$ in. to $2\frac{1}{2}$ in. in 50ft.

When you start at the outlet or waterway end of the bank, start on a grade of 2in. or $2\frac{1}{2}$ in., less if the erosion is not serious. At each erosion gully to be crossed, or at intervals of about 500ft., decrease the grade by $\frac{1}{2}$ in. At the last gully crossing, or when within 10 chains of the end of the bank, it is usually safe to use a true contour line, but put the last mark uphill about 4in.

When you start at the top, or high end, of the bank, use the true contour for several chains until you cross the first gully—increase the grade $\frac{1}{2}$ in. at every gully crossing. Don't use a grade of more than 3in. in 50ft. Steeper grades will gully.

In order to carry water without scouring, a bank should be about 18in. high with a broad flat channel at least 6ft. wide

across the bottom. Vee-drains carry too little water too fast and are totally unsatisfactory.

To run water efficiently, into a dam for instance, use fairly steep grades, e.g., 3in. in 50ft. The section of 10 chains furthest from the dam may be put on a 6in. in 50ft. fall, unless it will obviously pick water up in any quantity.

DODGING OBSTRUCTIONS

It becomes apparent soon after you start surveying, that rock heaps, trees and whitegum roots often occur on the line you are surveying. These obstructions prevent efficient construction of banks. If obstructions are not extensive they can be dodged by steepening the grade of the bank over a short distance.

Survey the line past the obstruction to make sure if it really is on the line and in the way. Place rear staff above or below the obstruction so that the line becomes steeper. If you are travelling downhill along the line, go below the obstruction and vice versa. Measure the vertical interval from this new point to the last peg; if this is more than 18in., re-run the complete line **starting below or above this difficult part**. If the vertical interval is less than 18in., run the line back the way you have come, on a grade of 5in. in 50ft., until you intersect the original line, delete the unwanted points and then continue the line on the normal grade.

OTHER USES

Rough Distant Sighting.

For finding points at a distance on the same level, we use instruments with which one can look along a horizontal line, for example, the dumpy level consists of a telescope kept level by a very accurate spirit level. One can also use a carpenters' spirit level, by sighting along the top.

At first glance, one would say the hose level is not a sighting instrument, readings are taken direct. However, when we bear in mind that no matter where the staves are placed, the two water surfaces are at the same level, the hose level has possibilities. A line from one water surface to the other is horizontal and a sight can be taken over these surfaces.

This method of sighting is used to find out approximately where a contour line will finish over the other side of the paddock. The two staves are held about 6ft. apart and one moved around until the water surfaces appear the same height as the top of the far fence. A contour line would finish near this point. A gradient line will finish about one chain above or below this, according to the way it flows. The same method can be used for finding out whether a water supply is above or below the level of a proposed tank or trough.

Finding Fall or Vertical Interval.

To find the fall:—

- (a) Between contour banks to get even spacing.
- (b) Between water supply and tanks, etc., in solving water reticulation problems.
- (c) To determine the safe height of a dam or earth tank wall before construction.

Start with the rear staff on the line or point from which you wish to measure. Move the leading staff in the required direction until the readings are different by 12in., put in a peg and move on. Repeat this and the rear man pulls out the previous peg. If this is done for every foot of vertical height, the number of pegs the rear man holds, is the number of feet vertically traversed.

USES NOT CONNECTED WITH SOIL CONSERVATION

For foundations, wooden or concrete floors, troughs, tanks, guttering, etc., the farmer can find a use for the hose level. An accuracy within $\frac{1}{8}$ in. in 50ft. can easily be obtained.

SPEED AND ACCURACY

The hose level has been checked for speed and accuracy against the dumpy levels, used by Soil Conservation Officers.

For vertical interval measurement and distant sighting the dumpy level is superior.

In some circumstances, contour surveying with the hose level may be quicker and is often more convenient. It can be used

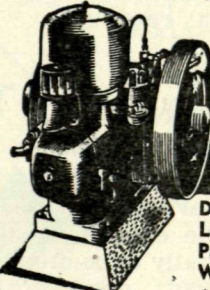
through trees and orchards, in drizzle and in strong wind. The two operators are in contact all the time and the more experienced man can take the lead and make decisions. This latter is not possible with the dumpy level, where the less experienced man takes the staff.

The writer has found, with nine months use of the hose level, that surveying for farm soil conservation works, with the farmer helping, is more convenient with the hose level. The standard dumpy level is better for distance sighting, lengthy traverses for water reticulation problems and checking soil conservation work.

The hose level used under practical conditions is only slightly less accurate than the better class dumpy level, but is well within the limits of accuracy required for soil conservation work. Tests carried out showed that the hose level is the only home-made levelling instrument that has sufficient accuracy for laying out all types of contour and grade lines in soil conservation work.

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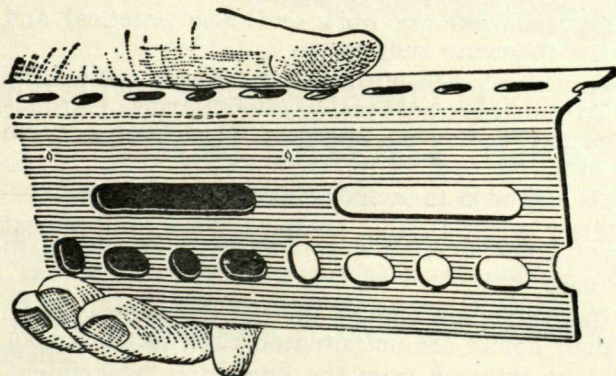
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Applications are now being invited for the two years' vocational course at the Schools of Agriculture commencing in February, 1956.

Applicants must be between the ages of 14 and 17 years and must have passed the Sixth Standard of the Primary school curriculum.

Applications must be made on the prescribed forms obtainable on request from the Education Department, Perth, and must be lodged prior to the 1st November, 1955.

The schools provide for post primary work and also practical and theoretical instruction in the following subjects:—

Farmwork, Blacksmithing, Tinsmithing, Carpentry, Building Construction, Dairying, Bacon Curing, Slaughtering, Gardening, Poultry Raising, Pig Raising, Shearing, Woolclassing, Farm Book-keeping, etc.

In addition the Course is extended to include the following subjects:—

At Narrogin.—Saddlery, Fruit Drying, Orchard Work, and Wheat Growing.

At Denmark.—Saddlery.

Students selected for the course are eligible for the living away from home allowance provided their homes are not situated close to the school.

Further particulars may be obtained from the Education Department, Perth.

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