A Separator for Sampling the Soil Fauna[1, 2]

JERRY M. MACKLIN[3] and B. ELWOOD MONTGOMERY, Purdue University

Occasionally it is desirable to sample as many of the insects found in a given soil as possible. Owing to the large number of extremely small insects encountered in the soil, a soil separator is almost indispensable. Several devices of different design have been used for this purpose. One of the more interesting is an ingenious device which was designed by Dr. George Salt (1952) for his studies on soil-inhabiting arthropods. Dr. Salt's theory and drawings were used as a guide in the design and operation of the equipment described here.

This particular soil separator was developed in an effort to secure a complete sample of the insects present in the soil of a clover field. To determine its effectiveness, the soil separator was compared with a device similar to the Berlese-Tullgren funnel described by A. H. Strickland (1947). A 40-watt bulb was used above the soil to dry it more slowly than the 60-watt bulb mentioned by Strickland. To compare the two devices, soil samples were divided in two equal parts. One-half was run through the soil separator and the other half was placed in the funnel. This test showed that the soil separator was more effective than the funnel, the ratio of the insects found being 6:1. It is probable that some insects still escaped detection in the separator, although precautions were taken to prevent this.

A. H. Strickland states that by using a 60-watt bulb suspended ten inches above the soil in a Berlese-Tullgren funnel for six days, all of the insects were driven out of the soil. Strickland's belief was based on the fact that, after being dried in the funnel, the soil was washed and examined with a hand lens, and no insects were found. It is not likely, however, that the insects were all driven from the soil. Ivar Tragardh (1933) suggests one explanation. He states that probably the smaller species die before they can escape from the soil. He also states that proper illumination and magnification are very important in determining the presence or absence of the smaller insects.

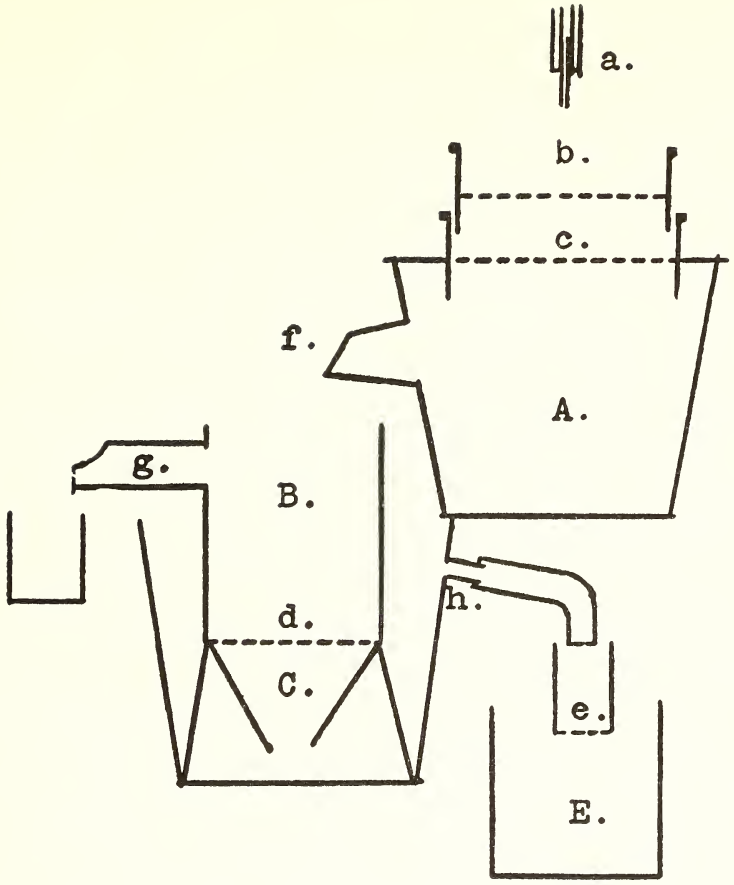
A diagram of the separating equipment used by the authors is shown by Plate A. The soil to be sifted is first moistened with water and then frozen. This breaks down the soil structure and makes it easier to run through the sieves. The soil may be held in the frozen state for a considerable length of time, if necessary, before it is sifted. The samples used by the authors were held in the frozen state for about twenty-four hours before being allowed to return to room temperature. After the sample is thawed it is placed on the first sieve, designated as

---

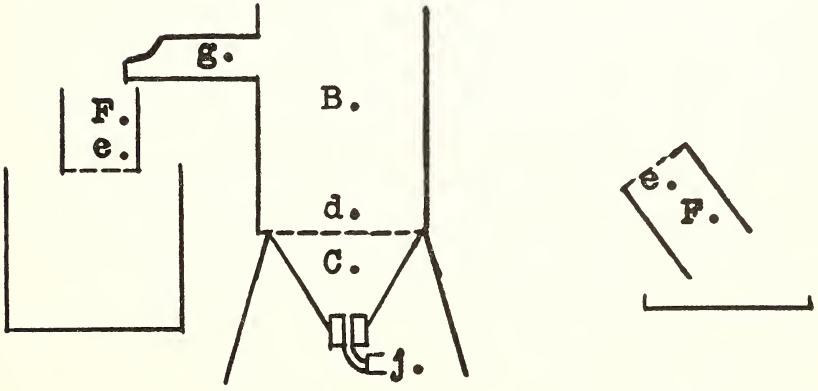
[1] Purdue University, Agricultural Experiment Station, Journal Paper No. 1046.

[2] This is part of a thesis submitted to Purdue University in partial fulfillment of the requirements for the degree of Master of Science.

[3] Present Address, Portland High School, Portland, Indiana.



1



2

Plate A. Diagram of Soil Separator.
Fig. 1. Entire apparatus in operating position.
Fig. 2. "Bubbling equipment" in operating position.
See accompanying text for explanation of parts and procedure.

b, Plate A. A jet of water is then played upon the soil causing it to break down into small particles. From here it is passed through the sieve *c* and into container A. These first two screens are standard soil sieves number 10 and number 30, respectively.

With the exception of the comparatively large specimens, such as cutworm larvae, most of the specimens are washed into container *B* which is suspended in water. At the bottom of container *B* is a .05 inch mesh bolting cloth sieve *d*. The water level is held above this sieve to prevent its becoming clogged with soil particles and root fragments. Any specimens which are small enough to pass through this sieve either flow out through spout *h* or settle to the bottom of the container. Because some of the specimens will fall to the bottom of the large sediment buckets, the contents of both must be sifted through a second bolting cloth sieve *e* of 0.1 inch mesh. Those specimens which are screened out on the second sieve are washed into petri dishes for inspection and determination.

For the specimens which are stopped on the .05 inch mesh sieve, however, a different technique is employed. Container *B* is especially designed with a detachable funnel *C* below the sieve. It is removable so that the cloth can be replaced when necessary. The funnel shape permits sealing it with a rubber stopper. By using a glass tube through the stopper, the bolting silk can be backwashed with a solution of magnesium sulphate. This solution, which is mixed to have a specific gravity of 1.2, causes the insects to float away from the root fragments more readily.

The bubbling equipment used to backwash the .05 inch mesh sieve is shown on Plate A. When container *B* is about three-fourths full of magnesium sulphate, air is bubbled through the tube *j*, causing the insects to float free from the root fragments and soil particles. This process is repeated a second time; then the level of the magnesium sulphate solution is raised until all of the specimens float through the spout *g* into cylinder *F* where they are caught on another .01 inch mesh sieve *e*. From this sieve the specimens are washed into petri dishes as before. A binocular microscope and a camel's hair brush are used for separating the specimens and transferring them into vials of preservative.

Table 1 shows the insects collected in six samples taken from a red clover field near Lafayette, Indiana, during the 1953 growing season. The samples were taken with a steel cylinder which removed a core of soil ten inches long and three inches in diameter. The first samples were divided into two inch sections for processing in an effort to determine whether or not the insects were more abundant near the surface. Little or no difference was found within the top ten inches in this particular field. Examination of a few deeper samples showed, however, that very few insects were present below the ten inch depth. This soil sampler, which was designed by Dr. A. R. Bertrand of the Agronomy department at Purdue University, is described in detail by Macklin (1956).

TABLE 1. Soil Insects Found in a Tippecanoe County Field.

Actual Number in Sample		Number Calculated per cu. ft.	
Sample I (IV-6-53)			
Thysanura	30	Thysanura	240
Collembola	350	Collembola	2,848
Coleoptera	1	Coleoptera	8
	387		3,096
Sample II (VI-23-53)			
Thysanura	13	Thysanura	317
Collembola	52	Collembola	1,369
	65		1,686
Sample III (VII-28-53)			
Thysanura	21	Thysanura	512
Collembola	9	Collembola	220
	30		732
Sample IV (VIII-13-53)			
Thysanura	8	Thysanura	195
Collembola	198	Collembola	4,831
Corrodentia	1	Corrodentia	24
Coleoptera	1	Coleoptera	24
Lepidoptera	7	Lepidoptera	171
Diptera	1	Diptera	24
Hymenoptera	60	Ants[1]	
Hymenoptera	183	Pupae[1]	
	459		5,269
Sample V (VIII-29-53)			
Collembola	145	Collembola	3,538
Coleoptera	1	Coleoptera	24
Lepidoptera	71	Lepidoptera	1,732
	217		5,294
Sample VI (IX-29-53)			
Thysanura	7	Thysanura	171
Collembola	187	Collembola	4,563
Lepidoptera	13	Lepidoptera	519
Hymenoptera	1	Hymenoptera	24
	208		5,277

[1] Only the actual numbers of ants and pupae collected are shown, because they are not indicative of the number per cubic foot throughout the field.

Literature Cited

1. MACKLIN, JERRY M. 1956. The insect fauna of red clover. Unpublished Masters Thesis, Purdue University.
2. SALT, GEORGE. 1952. The arthropod population of the soil in some East African pastures. Bull. Ent. Res. **43**:203-220.
3. STRICKLAND, A. H. 1947. The soil fauna of two contrasted plots of land in Trinidad, British West Indies. Jr. Anim. Ecol. **16**:1-10.
4. TRAGARDH, IVAR. 1933. Methods of automatic collecting for studying the fauna of the soil. Bull. Ent. Res. **24**:203-214.