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Soil monolith construction: a practical teaching experience for field and lab

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SOIL MONOLITH CONSTRUCTION

A practical teaching experience for field and lab

INTRODUCTION

Soil formation, structures and differences are difficult to visualize or understand without being able to experience them. Most of us are familiar with the soil profiles (soil sequum) on display in many Soil Conservation Service or County Extension Service offices. Whether an ecologist, engineer, or home gardener, we have all examined the intricate structures, features and horizon development. The objective of this paper is to describe a technique to construct such soil monoliths for classroom use with minimal expense.

Soil acquisition and monolith construction techniques have been previously described (Arneman, 1954; Berger and Muckenhirn, unpublished). Although the techniques were described in detail, actual construction was tedious, cumbersome and often doomed to failure. There were generally two causes for failure: 1) attempts were made to remove the soil sequum as a single unit, and 2) high quality plastic resins were not yet available. Personal communications with Professors Hole and Muckenhirn of the Department of Soil Science, UW–Madison and Mr. C. L. Glocker, Soil Conservation Service reinforced the position that soil monoliths were difficult to construct as well as being outdated. Alternatively, the ease in collection and construction of miniature monoliths as examples of special features proved to be more efficient, portable, and useful.

We felt the removal of small segments (Arneman, 1954) and features from the context of the soil sequum would render interpretations difficult, if not meaningless, in the classroom.

As teaching aids, 35mm slides are often used in lieu of actual soil samples. Although compact and lightweight, slides alone are insufficent to provide adequate examination of the soil sequum. Reflections or shadows may often conceal structures and features. Color quality is often not representative depending on the photographer's skill and the film type used.

Although not as effective as actual field studies, permanently mounted soil profiles in plastic resin can be a valuable instructional aid. Supplemented with 35mm slides, the profiles can enhance the concepts and definitions of soil features and structures presented in lecture and text. When used with the County soil surveys (USDA, 1970; USDA, 1971) and the current 7th Approximation classification system (SSSA, 1960), the full-length soil profile becomes a valuable tool.

MATERIALS AND METHODS

The actual location of a specific soil in the field can be a challenging experience for students. Skill in reading soil maps and the landscape are necessary to the ultimate construction of the desired monolith.

County Soil Surveys, available from the USDA Soil Conservation Service, are essential in locating areas where soil types of interest exist. Certain topographic features can facilitate soil profile excavation. Roadcuts, streamcuts, construction sites, and eroded gullies can greatly reduce excavation time and effort.

Once a suitable site was located, a pit was excavated to approximately 1.5m in depth using a long-nosed spade and an army trenching tool. The vertical surface was gently brushed to remove loose material and to expose the soil sequum and prominent soil features which may have been obscured by digging. The profile was compared to the SCS description for the location and soil type. Once verified, the profile was removed in segments.

Using a rubber mallet, a galvanized steel (.2m x .2m) sheet was driven horizontally into the vertical soil face approximately 20cm from the surface *(Fig. 1)*. A second sheet was driven vertically, downward, 10cm behind the soil face until contact was made with the horizontal sheet. Cutting downward from the surface to the horizontal sheet with a butcher knife releases the sides of the soil segment, or block. The sides of the soil segment were trimmed to insure a snug fit when placed into the wood soil form.

To construct a 1 meter monolith, we used a wood form that measured 1m x .15m x .05m. The 1 meter monolith required about 7 soil segments of varying lengths. Segment size should be kept small enough for easy handling. However, care must be exercised to avoid disrupting soil horizon boundaries and other soil features. We found no difficulty in preserving the soil sequence. The thin cut between segments filled naturally when segments were abutted in the wood form.

When a 1 meter sequum was completed within the wooden form, it was shaved with a galvanized sheet to make the soil surface level with the sides of the

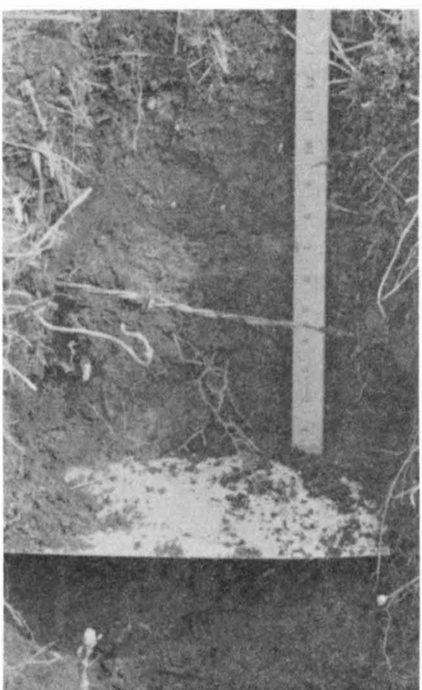

Fig. 1. Using a rubber mallet, a galvanized sheet is driven horizontally in the soil face approximately 20 cm beneath the surface or previous segment.

frame. Care must be exercised in preparing the surface. Plant roots are left in place and can be easily snagged, pulling the soil apart. A toothbrush was used to remove loose soil and reveal structural features *(Fig. 2)*. Sears polyurethane clear plastic varnish (satin finish) was then spread evenly over the profile until it was saturated. The addition of the varnish was done while the soil was moist to preserve the original soil color. At least 4 days was required for drying. The finished product dried rock-hard with realistic color hues. We found the satin finish varnish to be the most satisfactory, since glossy features were not desired. A 1 meter monolith requires approximately 1 liter of varnish, depending upon the bulk density of the soil. We used Poygan and Ozaukee series loams.

We also used smaller wooden forms, varying in shape, to preserve outstanding soil features as gleization, concretions and blocky structures. Although the 1 meter monoliths were large and heavy, we found their extra width useful when small rocks were to be included.

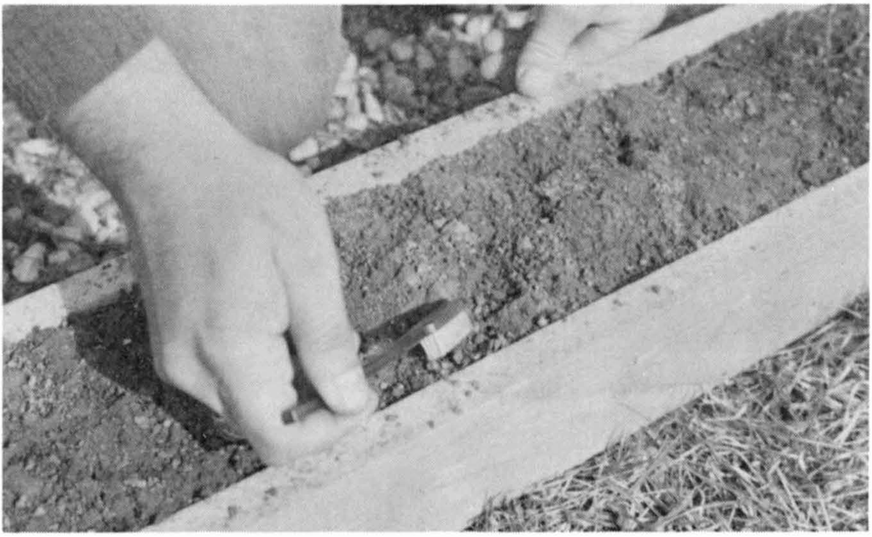

Fig. 2. A toothbrush was used to remove loose soil and reveal structural features.

CONCLUSION

The objective of constructing soil monoliths is to bring a part of the "field" into the laboratory for a closer examination of soil structures, features and horizon development. The actual field work provides the student an opportunity to study soils *in situ* under the formative environmental parameters: topography, vegetation, soil moisture, parent material, climate, and man's influence. The potential exists for the student to evaluate the landscape, use a soils map and make field interpretations. Finally, construction of the monolith provides an insight into the work performed by the USDA Soil Conservation Service.

We agree that full-sized soil monoliths, contrary to current opinion, are of great value in the classroom as teaching aids. Construction of the monoliths by segments is faster, easier, and less prone to disaster than the popular 1 piece extraction method. The removal by segments causes no significant alteration of the sequum. Time expended in the field for excavation and construction was minimal in each case, less than two hours. We feel our techniques for the construction of soil monoliths is economical both in time and equipment cost *(Fig. 3)*.

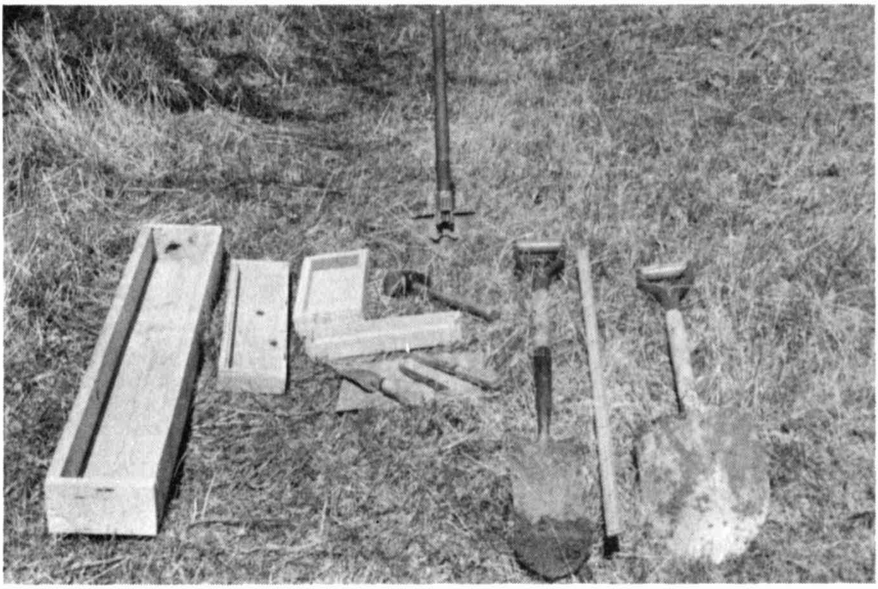

Fig. 3. Equipment was of the garden variety and soil forms were constructed from scrap lumber.

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