A METHOD FOR THE MICROSCOPIC EXAMINATION OF THE NATURAL STRUCTURE AND PORE SPACE IN SOILS

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Microscopic studies of soil structure have been limited because the natural arrangement of soil particles or aggregates is easily disturbed, and methods have not been available for the preparation of thin sections or smooth surfaces for examination. Pigulevski (4) devised a method of soil fixation which was used by Miscenko (2) in studying structural changes produced by the movement of farm machinery over the surface of the soil. Microscopic examinations can also be made (5) of undisturbed soil which should be dried at 105°C. and placed in a container which can be evacuated with the fixation mass containing three parts of paraffin and one part of napthalene. This material is melted by gentle heating, and the air is removed with a vacuum pump. When the vacuum is released, the mixture of paraffin and napthalene is forced into the soil pore space. After the container is cool, the soil which is imbedded in the paraffin-napthalene mixture is removed, and it can be cut and polished for microscopic study. Harper (1) studied the effect of various substances which could be used to hold soil particles together in order that satisfactory monoliths could be mounted for laboratory study and exhibition, and found that a dilute solution of lacquer was superior to other materials which were applied to the soil. Sodium silicate is not as satisfactory as lacquer although it has been recommended because of its low cost, by Morwick (3).

Physical measurements can be made to determine percentage of capillary and non-capillary pore space and the stability of soil aggregates, but the natural arrangement of particles within clusters or granules has not been studied by many research workers. In this investigation an attempt was made to find a method which could be used to hold the soil particles and the structural character of different soils could be photographed similarly to a method which is used in a study of thin sections of minerals or different types of steel. The following materials were prepared in this investigation: colorless black lacquer, sodium silicate, paraffin, napthalene, white enamel, Canada balsam, and mixtures containing barite and other substances. Thin lacquer penetrates porous substances readily, and no heating is required when this material is applied to soil. It dries quickly and cements soil particles into a solid mass. Ordinary brushing lacquer, diluted with two parts of lacquer thinner and applied to a lump of soil can be dried in a current of air or in an electric oven in a few minutes. When a treated mass of soil is being ground in order to prepare a smooth face for microscopic examination, additional applications of thinned lacquer should be applied if microscopic examination indicates that a disintegration of the soil structure is occurring during the grinding process. Two or three applications may be needed to develop the cementing effect when large particles of quartz or other hard minerals are encountered. When a smooth surface with a high polish has been obtained by grinding one side of an undisturbed block of soil with fine emery paper, it is cemented to a glass slide with colorless lacquer, and the opposite side of the soil mass is ground until a thin section is obtained. Dust particles collecting in the large pores must be carefully removed before additional lacquer treatments are applied. A petrographic microscope was used to obtain the photographs of non-capillary pore space, which are shown in Figures 1 and 2. Two photoflood lamps were located about 18 inches from the microscope stage and the thin sections of soil were illuminated with both reflected and transmitted light. An exposure of one-half second was required.