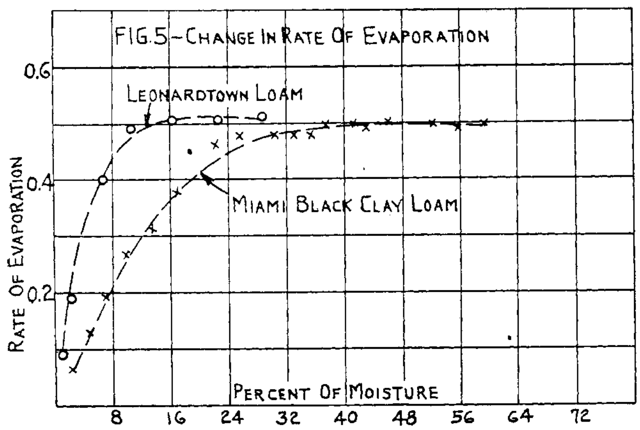
clearly how this change in rate of evaporation takes place.

From the consideration of the changes taking place in the soil it is evident that the conditions of the soil are not constant. The composition as well as the physical properties of the soil is constantly changing and these changes must be considered in any study of soil conditions. The largest and most important changes in the soil are wrought by a changing water content. The influence of these changes follow a definite law and with this understanding of the influence



of moisture variation, it remains to investigate the amount of such changes due to specific soil conditions.

SUMMARY

The engineering properties of the soil are the properties of interest from the physical standpoint and are identical with those physical properties of importance to agricultural operations.

The factors influencing the physical properties are mechanical composition, mineralogical composition and moisture content. All of these are constantly changing, but the greatest variation occurs in the moisture relations of the soil.

A study of the moisture relations has demonstrated the fact that all of the physical properties change with a changing moisture content and with any given soil there is a particular moisture content at which the properties either reach a maximum or minimum value; this moisture content is the critical moisture content of the soil.

The soil, if allowed to become wet and dry out several times, reaches a condition of compactness known as "natural packing." This compactness varies with the moisture content just as the other physical properties do.

The study of the engineering properties of the soil will consider the changes due to specific soil conditions, but must recognize the dynamic soil conditions.

BUREAU OF SOILS
U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON

LITHIUM IN SOILS

By L. A. STEINKOENIG

Received January 6, 1915

Lithium is very widely, though not abundantly, distributed in nature. It has been found in a large number of sedimentary rocks examined by A. Hilger,[1] in a great number of primary rocks, granites, syenites and gneisses, by L. Dieulafait,[1] and in many varieties of marble, calcareous rocks and English chalk by Kirchoff and Bunsen.[2]

Lithium is also very often found in mineral waters and salines. It has been found in the larger bodies of water: in the Dead Sea, by Dieulafait[3] and in the waters of the Mediterranean Sea, Red Sea, Indian Ocean, Chinese Sea, Atlantic Ocean, Antarctic Ocean and the Northern Ocean by the same author,[4] the concentration of lithium being great enough in the waters of the Mediterranean to make it easy to detect in the residue from one cubic centimeter of water.

Being so widely distributed in rocks one would expect to find lithium in the soil and plants supported by the soil. Beet[5] and tobacco plants take up considerable quantities of this element from the soil. Lithium was found in tomatoes, chick peas and Iris germinica by Passerine[6] and in a great number of plants growing exclusively in Austria by Tschermak.[7] Bunsen and Kirchoff found lithium in the ash of the wood of trees grown on a granite soil and in the ash of all kinds of cereals grown in the valley of the Rhine.

Lithium has also been found in the blood and muscles of man and ruminant animals by Kirchoff and Bunsen and in nearly all the organs of the human body by Herrmann.[8]

Lithium has been known to be present in soils, for a long time, but there are few quantitative estimates of this element. It was found present in all soils examined by Robinson.[9]

The lithium was obtained together with the sodium by the J. Lawrence Smith method and the excess of platinum used to precipitate the potash removed by treatment with hydrogen sulfide. The lithium and sodium salts remaining in solution are filtered and concentrated to small volume.

The lithium was determined by means of a Hilger wave length spectroscope using the line of 6708.2 wave length. The intensity and duration of the line, compared with that of a standard solution, served to measure the content of lithium. The method of comparing the spectra of unknown and standard was very similar to that of Truchot, with the use of platinum spiral and addition of sodium chloride to standards as described by Skinner and Collins.[10]

A blank determination showed small amounts of lithium in reagents but not enough to interfere with the determination. To determine whether appreciable amounts of lithium are volatilized during heating twice to drive off ammonium salts, standards were made by adding lithium, in amounts occurring in soils, to powdered quartz. No loss of lithium occurred

[1] *Deut. Chem. Ges. Ber.*, **8**, 335.

[1] *Ann. chim. phys.*, [5] **16**, 377–391.
[2] *Chem. News*, **98**, 151–2.
[3] *Compt. rend.*, **94**, 1352–1354.
[4] *Ann. chim. phys.*, [5] **16**, 377–391.
[5] von Lippmann, *Ber.*, **30** (1897), 3037–3039.
[6] *Staz. Sper. Agrar.*, **20**, 471–476.
[7] *Zeit. Landw. Versuchs-Wesen. Oesterr.*, **2**, 560–572.
[8] *Pflüger's Archiv.*, **109** (1905), 26–50.
[9] *Bull.* **122**, Bureau of Soils, U. S. Dept. Agriculture, 1914.
[10] Skinner and Collins, *Bull.* **153**, Bur. of Chem., U. S. Department of Agr. (1912).

Soils Analyzed for Lithium	Per Cent Lithia Soil	Subsoil
Soils of River and Flood Plains Province		
Cahaba Fine Sandy Loam, Clay County, Ga.	0.002	0.004
Cahaba Very Fine Sandy Loam, Minden, La.	0.001	0.002
Soils of Glacial and Loessial Province		
Memphis Silt Loam, Grenada Co., Miss.	0.002	0.002
Memphis Silt Loam, Smooth Phase, Grenada Co., Miss.	0.001	0.002
Carrington Loam, Lawville, Wis.	0.002	...
Gloucester Stony Loam, 3 mi. E. Marlboro, N. H.	0.003	...
Volusia Silt Loam, 3½ mi. S. W. Naples, N. Y.	0.003	...
Soils of Coastal Plains Series		
Ruston Fine Sandy Loam, Minden, La.	0.002	0.003
Susquehanna Clay, Clark Co., Miss.	0.008	0.007
Susquehanna Fine Sandy Loam, Smith Co., Texas	0.003	0.003
Orangeburg Sand, Terrel Co., Ga.	0.002	0.003
Norfolk Fine Sandy Loam, 3 mi. S. W. Murphy, Colquit Co., Ga.	0.003	0.003
Susquehanna Fine Sandy Loam, Colquit Co., Ga.	0.002	0.003
Portsmouth Fine Sandy Loam, Colquit Co., Ga.	0.003	0.004
Tifton Fine Sandy Loam, Bellville, Ga.	0.002	0.004
Soils of the Limestone Valley and Upland Province		
Hagerstown Loam, 1 mi. N. W. Conshohocken, Pa.	0.010	...
Soils of Great Plains Province		
Oswego Silt Loam, 2 mi. N. W. Manhattan, Kan.	0.003	...
Colorado Sands, Greeley, Col.	0.002	...
Soils of Piedmont Plateau Province		
Louisa Loam, Trevilians, Va.	0.003	...

during the analysis of these standards. Approximately the same amount of sodium chloride as the soil samples contained was added to the standards.

The soils were taken from six different areas. The results of the analyses are given in the accompanying table.

Lithium, although occurring in small amounts, was found present in all soils examined and in many cases in larger amounts than rubidium[1] is usually found. The content of lithium does not seem to follow that of any other element in the soil. Nearly the same amount of lithium is found in soil and subsoil but in most cases the proportion found in the subsoil is greater.

Bureau of Soils
U. S. Department of Agriculture, Washington

LABORATORY AND PLANT

SAND BLAST FOR MARKING GLASSWARE

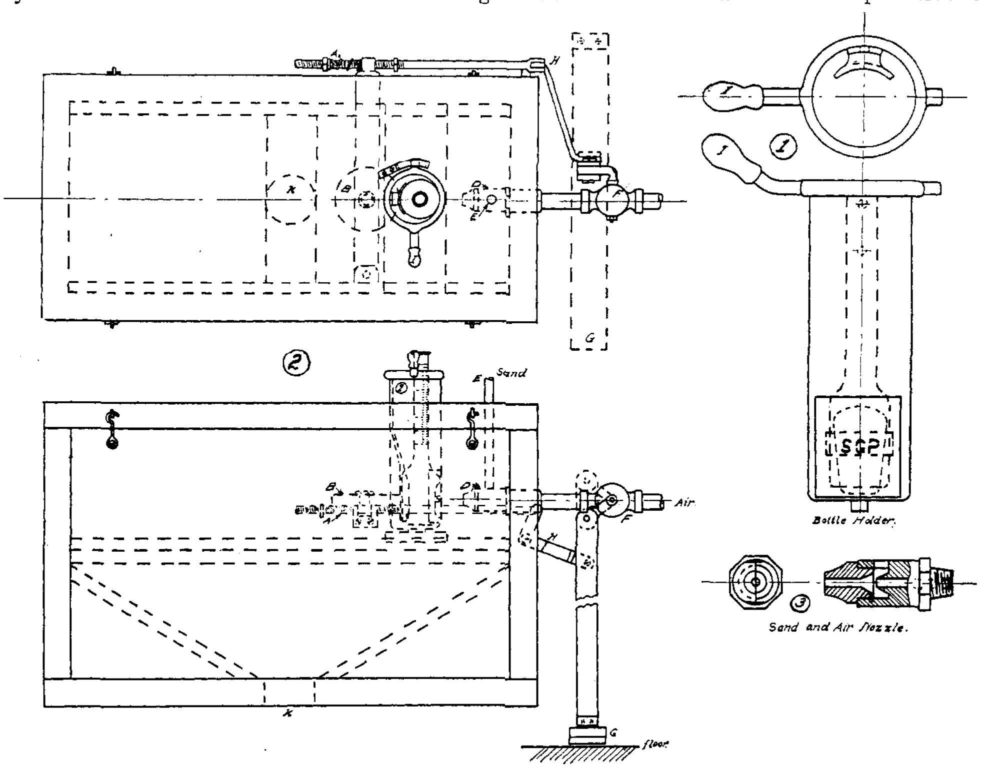
By George Spitzer and L. S. Trachsel

Received March 19, 1915

Sometime ago it became necessary for the senior writer to devise a means for marking glassware. The main objects desired were rapidity, economy and durability. Where large quantities of glassware are to be marked rapidity is very essential. The method of using an emery wheel or emery paper answers the purpose quite well where only "spot etching" is required and the glassware is sufficiently strong to withstand the pressure of the rapidly moving emery wheel or emery paper. When lettering is to be done other methods are resorted to, and the so-called diamond ink or hydrofluoric acid method is sometimes used. Before employing either hydrofluoric acid or diamond ink for effective etching it is necessary that the glassware be warmed and free from grease or dirt. The rubber stamps used for applying the etching agent clog up with the paste, making frequent cleaning necessary and also making the whole operation very slow and sometimes unsatisfactory. In addition the etching done by the hydrofluoric acid is fine-grained and soon becomes very faint if the glassware is handled to any great extent. This is true when grease or greasy substances come in contact with the etching.

To overcome these difficulties an effort was made to devise a sand blast, embodying the features necessary for rapid work, economy in various relations and one that would give durable markings. In this we believe we have succeeded, in a great measure, and it is hoped that perhaps others who may have occasion to make use of the sand blast may find some suggestions in our description and drawings.

The sand blast devised by the writers has given excellent results in marking Babcock test bottles. It is easy to manipulate, economical and rapid. From the drawing it will be seen that the manipulation is very simple; the bottle to be marked is placed in a cylindrical receptacle (bottle holder), the bell-crank presses the bottle against the stencil, the air cock is opened and the sand forced against the stencil. At the same time the cylinder is rotated by the hand sufficiently to expose the letters to the blast; when the turn is made the foot-lever is released which cuts off



Sand Blast

[1] *Bull.* **122**, Bureau of Soils, U. S. Dept. Agriculture, 1914.