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DETERMINATION OF THE THICKNESS OF FROZEN GROUND

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by

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Translated by Mrs. Séverine Britt

U. S. Geological Survey

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DETERMINATION OF THE THICKNESS OF FROZEN GROUND  
(A translation)

GAILLEUX, André, and THELLIER, Emile; Sur la détermination de la couche de sol gele; Comptes Rendus des Séances de l'Académie des Sciences, Paris, Tome, 224, No. 16, pp 1174-1175, 1947.

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Little is known on soil frost because of the lack of sufficiently simple measurement devices. However its study is proving so important for agronomy, hydrology and public works that it gives rise to more and more research. Recently Kirk Bryan\_/ proposed for this study the name

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\_/ Amer. Jour. Sci. 244, 1946, pp. 622-642.

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of cryopedology.

In their research for a process for measuring the layer of frozen ground, the authors gave up the direct method of the agronomists, which is not very precise and is too difficult. They also gave up the thermometric observations (ordinary thermometers with platinum resistance or thermoelectric), which are too long and costly, and they resorted to the actual freezing of water. A cylindrical tube of glass 80 cm long, 30 mm in diameter, and 2 mm thick is permanently set upright in the soil; its lower end is closed, and the upper end which emerges a few centimeters above the surface is capped with a small cover. It is known from another source (ordinary measurement of the soil temperature) that in these conditions, the temperature of the tube atmosphere is at each point equal to that of the incasing ground. A wooden stem inside the glass tube and of the same height as the tube is graduated in half

centimeters, the zero coinciding with the surface of the ground. One side of this stem is flat, and horizontal glass tubes (20 mm long and 4 mm in diameter) are set in notches cut in the stem and regularly spaced 6 mm apart. These glass tubes are open at both ends and filled with water which is held there by capillary action. Water may freeze in these tubes without breaking them and the thickness of the layer of frozen ground can be read by pulling out the stem and by observing the position of the ice in the tubes. The device is thus very simple, reading is direct and almost instantaneous, and the precision of the measurement is excellent; the variations noted from one day to the other correspond to a real phenomenon.

A stronger device is in preparation which the outside glass tube will be replaced by a tube of ceramic, and the wooden stem by one made of plastic material. Coloration of water to improve the visibility of frost action, and closing of the small tubes are being tested.

The described apparatus was placed at the Observatory of Parc Saint Maur (Paris) on December 1, 1946, in a turfed soil, and it was read every day at 3 P.M. Thus it was possible last winter to follow the freezing action in the soil during each cold period, and also the progress of thawing from the top and from the bottom. On the other hand, current measurements of temperature of air under a shelter, and that of soil temperature at depths 0.30m, 0.65 m, and 1 m. being made in the immediate neighborhood of the cryopedometer, precise record was obtained on the thermic evolution of the surface of the turfed soil at the Observatory during one winter; in this evolution the circulation of the aqueous vapor from the warmer soil toward the frozen layer, where it condenses, seems to play an important role.

As an example, the upper and lower limits of the frozen ground (counted in cm) at 3 P.M. during the hardest freezing period of winter 1946-47 are given below; the indication 0 for the upper level evidently corresponds to the frozen soil at the surface.

January 1947

Date	22	23	24	25	26	27	28	29	30	31
Upper level	0	0	0	0	0	0	0	0	0	0
Lower level	0	2	3	5	8	10	12.5	14	23	24

February 1947

Date	1	2	3	4	5	6	7	8	9	10
Upper level	0	0	3	5.5	7	7	7	6.5	7.5	0
Lower level	24	23.5	23	16	16	16	16	15	12.5	0