been lengthened to make more serviceable to his fellow-beings the art of healing, in both its preventive and its curative ministries. There is nothing left to wish him but still more years in the practice of this art before he "goes to the stars."—*The New York Times*.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

HEAT TRANSMISSION THROUGH BLANKETS

SOME three years ago I was approached by a large manufacturer of blankets with the request to devise a method for measuring the "heat-retaining property" of blankets. These tests were to be not only for the sake of determining the coefficient of heat conduction of various kinds of blankets, but especially for the purpose of obtaining some data on the basis of which blankets could be improved.

There were, of course, the usual well-known methods available, but it seemed desirable to test larger samples than were generally used and also under conditions which more nearly resembled actual usage. Since what we may call the "normal conditions" for a blanket in use are based on body temperature and room temperature, I devised an apparatus in which the heated body was kept at 37° C. (98.6° F.) and surrounded by air at the temperature of a cool room, 13° C. (55.4° F.). The apparatus finally took the form shown in Fig. 1.

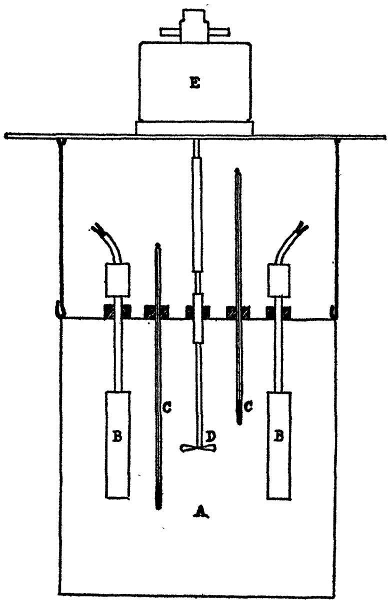

FIG. 1

A is a copper vessel 12 x 12 x 3½ inches, rounded at the sides and bottom and closed with a flat plate at the top. In the plate are five apertures from which are suspended by rubber or cork stoppers two immersion heaters B, two thermometers C and an agitator D, run by a motor E. The thermometers are placed so that one has its bulb a few inches below the center of the body and the other as much above. The vessel is filled with water, and when the stirring device is in motion the difference between the two thermometer readings is about 0.1° C. The body is suspended from the upper shelf of the food compartment of an electric refrigerator and the stirring motor is placed on this shelf and connected to the propeller shaft by rubber tubing. The temperature of the air in the food chamber is controlled by a Tagliabue Snapon controller, the bulb of which is not in the brine but in the food chamber, behind the body and near the back wall of the refrigerator. This control gives a maximum variation of about 1½° C. from mean.

The energy is supplied to the heaters by a storage battery and measured by a precision voltmeter and ammeter. The temperature of the body is measured by the two thermometers C, and the temperature of the box by two thermometers not shown in the figure, one placed in front of the body near the door and the other near the right-hand wall of the refrigerator. A cardboard screen placed directly inside the door of the refrigerator and low enough to enable the reading of the thermometers prevents the cold air from rushing out when the door is opened for observations.

The procedure in making tests is as follows. The blanket to be tested is cut in the form of a rectangle 17 x 32 inches and pinned into the shape of a bag which fits over the body snugly but without strain. It is drawn on from below and pinned together at the top, allowing B, C and D to project through. The current through the heaters is now adjusted until the average temperature of the body is 37° C. This of course takes a considerable length of time. The temperature of the box is constantly changing with the turning on and off of the compressor, and inasmuch as an increase above 13° decreases the flow of heat through the blanket and a decrease below 13° increases the flow of heat, there is an accompanying variation in the temperature of the body even though the power supplied remains constant. The rate of variation is of course the same as that of the refrigerator but there is a slight lag. The amplitude of variation of the body temperature depends upon the insulating quality of the blanket used and becomes unnoticeable in case of the "warmest" ones. The rate of change of the refrigerator temperature depends upon the quality of the blanket used and the room temperature and is greatest for a poor blanket and a high room temperature, as the rate of flow of heat into the refrigerator is then the greatest and the compressor has to work most often.

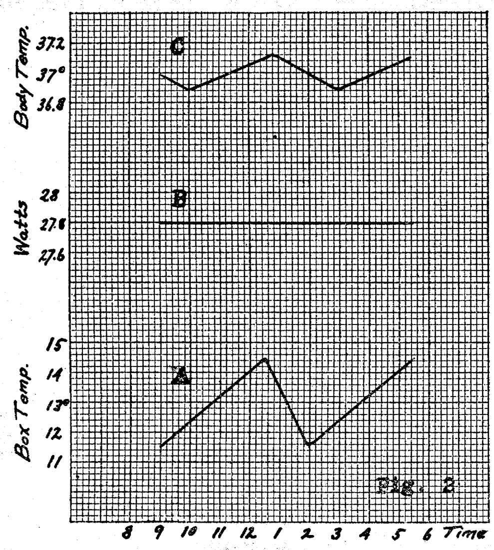

FIG. 2

Fig. 2 shows plots of readings obtained in the test of a good cotton blanket. Curve A shows the variation of the box temperature with time; curve B the power supplied to the body, and curve C the resulting temperatures of the body. The power in watts supplied to the body when its average temperature is 37° while the average temperature of the box is 13° is a measure of the heat-insulating property of the blanket under test. It may be mentioned here that the power supplied to the stirring device is insignificantly small.

Inasmuch as the number of watts which have to be supplied to the body is least for the best blanket it seemed desirable to obtain a measure which was numerically greater for the better insulator. This was done by determining the watts needed when the body was covered with only a cotton sheet in place of a blanket and using as the measure the difference between this value and that for a given blanket. This difference, of course, is greatest for the best blanket.

Knowing the area of the covering and the power supplied, it is possible to compute the energy in B. T. U. which passes through ten square feet of any blanket in eight hours. This I have adopted as my unit in blanket testing. An interesting result obtained was that a single thickness of heavily napped cotton blanket gave 2,730 of these units, which corresponds to the heat value of about two thirds of a pound of lean beef.

M. F. WEINRICH

DEPARTMENT OF PHYSICS,
COLUMBIA UNIVERSITY

SPECIAL ARTICLES

THE EFFECT OF COLLOIDAL SILICA ON THE ABSORPTION OF PHOSPHORIC ACID BY PLANTS

REPLYING to a criticism of Fisher[1] concerning the interpretation of the effect of sodium silicate in increasing the assimilation of phosphoric acid by barley in the Rothamsted field experiments, Hall[2] suggests that an explanation of the phenomenon may be sought in the colloidal behavior of the sodium silicate in accordance with the theory advanced by Comber.[3] The latter maintains that the soil colloids play an important rôle by being directly absorbed by plants through the formation of a one phase system between the colloidal coating of the plant root hairs and the colloidal coating of the soil particles. This proposed modification[3] of present views by Comber,[3] however, has been critically discussed by the writer,[4] who has shown that the weight of existing evidence does not support the theory of the absorption of colloids by plants.

There is ample evidence,[5,6,7,8] moreover, to disprove the view that silica may act as a substitute for phosphoric acid in the metabolic processes—it is not "phosphorsäuresparend"; nor can the view[9] that the observed effect is due to the improvement in the physical condition of the soil withstand critical investigation.[10] Relative to the alternative explanations presented by Hall and Morison,[7] certain authorities[1,6,8] have concluded from the increased quantity of phosphoric acid per dry weight of the crop that the beneficial effect of silica is due to the increased availability resulting from an increase in the quan-

[1] R. A. Fisher, *Jour. Agr. Sci.*, 19: 132–139, 1929.

[2] A. D. Hall, *Jour. Agr. Sci.*, 19: 586–588, 1929.

[3] Norman M. Comber, *Jour. Agr. Sci.*, 12: 363–369, 1922.

[4] Walter Thomas, *Soil Sci.*, 27: 249–270, 1929.

[5] Wl. S. Butkewitsch and W. W. Butkewitsch, *Biochem. Ztschr.*, 161: 468–487, 1925.

[6] P. L. Gile and J. G. Smith, *Jour. Agr. Res.*, 31: 247–260, 1925.

[7] A. D. Hall and C. G. T. Morison, *Proc. Roy. Soc.*, B–77: 455–477, 1906.

[8] O. Lemmermann, H. Wiessmann and K. Sammet, *Ztschr. Pflanzenernähr. u. Düngung*, 4A: 265–315, 1925.

[9] Fr. Duchon, *Ztschr. Pflanzenernähr. u. Düngung*, 4A: 316–325, 1925.

[10] O. Lemmermann, *Ztschr. Pflanzenernähr. u. Düngung*, 4A: 326–330, 1925.