LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Relativistic Theory of a Rigid Body

GARDNER[1] has recently given a new relativistic theory of a rigid body, and Synge[2] has applied this theory to the earth considered as a rigid body in rotation. He predicts, on the basis of the Gardner theory, that the fringes in a Michelson interferometer with one arm inclined at 45° to the horizontal should shift on rotating the interferometer about a vertical axis—provided that the interferometer is rigidly attached to the earth. The fringe shift predicted is $\left(\frac{E}{c}\frac{D}{\lambda}\right)\sin\theta$, where E is the velocity of earth's rotation, D is the length of the arm of the interferometer and θ is the angle between the projection of the direction of the inclined arm on a horizontal plane and a line pointing north[3].

We have made the following experiment to look for the predicted shift. A Michelson interferometer (made by Messrs. Hilger–Watts) was modified: (*a*) by mounting it on a suitable stand so that the arm along which the light enters is horizontal and the other arm is tilted so that the observer looks downwards along a line at 45° to the horizontal; (*b*) by clamping the movable carriage to the bed of the interferometer to give an arm of fixed length (approximately 12 cm.); (*c*) by extending the other arm to about the same length. The apparatus was clamped to the table of a large drilling machine. This table could be unclamped for rotation or clamped to the base of the drilling machine. The floor was of bituminous material, into which the feet of the machine were embedded. Underneath this was a concrete raft resting on earth.

The 5461-A. line of mercury obtained from a low-pressure source mounted on the drilling table was used. The instrument was adjusted to give about three straight-line fringes in the field of view. They could be regarded as localized on the mirror opposite the observer, who looked in through a pinhole. A line drawn in the silvering of the mirror was used as a reference mark.

The interferometer was arranged so that the observer looked along a line pointing westwards (and downwards). The position of the fringes was observed (1) with the table clamped and (2) with it unclamped. The table was then slowly rotated by hand, the observer viewing the fringes during rotation. When the table had been rotated through 90° so that the observer looked in a northerly direction, the rotation was stopped and the position of the fringes noted with the table clamped and with it unclamped. The table was then rotated through a further 90°, and the position of the fringes was again observed with the table clamped and with it unclamped.

The following results were obtained: (1) no significant change in the position of the fringes was obtained on clamping or unclamping the table, (2) during rotation the fringes vibrated with an amplitude of about 0·1 fringe, but on stopping the rotation they came to rest in the original position. In the best tests, a shift of 0·05 fringe should have been observable and no shift was observed. The shift calculated from the above formula is 0·42 fringe, and since 0·1 fringe could easily have been detected we conclude that the predicted shift does not take place.

We wish to thank Prof. J. L. Synge for a private communication in which he discussed the conditions to be fulfilled in testing the theory.

R. W. DITCHBURN
O. S. HEAVENS

Physics Department,
University of Reading. Sept. 8.

[1] Gardner, G. H. F., *Nature*, **170**, 243 (1952).
[2] Synge, J. L., *Nature*, **170**, 243 (1952) *Sci. Proc. Roy. Dublin Soc.* **26**, 45 (1952).
[3] Synge, J. L. (private communication).

Permafrost Drilling and Soil-Temperature Measurements at Resolute, Cornwallis Island, Canada

IN August 1948, a drilling programme was carried out at Resolute, N.W.T., Canada, lat. 74° 41′ N., long. 94° 54′ W., to locate a suitable site for a future seismological station. When this had been completed, a series of shallow holes was drilled about 100 ft. north of the weather station operations building, and ceramic resistance thermometers were inserted at depths of 8, 18, 39 and 60 in.

In 1950 it was decided to extend the scope of this investigation and attempt to obtain information from much greater depths in the permanently frozen ground. A maximum depth of 1,000 ft. was set as the objective. This project was made possible by the joint efforts of the Meteorological Division of the Canadian Department of Transport, the United States Weather Bureau, and the Dominion Observatory of Ottawa, Canada.

To begin each hole, a 2½-in. pipe was driven to bedrock with a 350-lb. hammer. It was found in each case that the overburden was approximately 6 ft. thick and consisted of frozen gravel. The bedrock was limestone with occasional faults and cracks. The drill hole had a diameter of 1½ in. and recovered core with diameter 15/16 of an inch.

Holes were drilled to depths of 6, 11, 23, 30, 50 and 103 ft. and cables with temperature elements were inserted in each. All the core was recovered from the 103-ft. hole. The most serious problem encountered was the maintenance of an adequate circulation of hot water in the drill hole to prevent frost formation.

An improved hot-water boiler and pumping equipment were provided in 1951 and a further attempt was made to drill to a depth of 1,000 ft. Water for the drilling was obtained by pumping it directly from a lake 1,500 ft. distant, and drilling operations were carried on around the clock. As the drilling proceeded to greater depths, the circulating water had to be heated to a correspondingly higher temperature. The valves and plungers of the pump did not stand up too well under the increased heat and pressure, and breakdowns occurred frequently.

Out of a total of seven holes which were drilled during the period from the first week of July until August 20, five holes were lost. Three were lost due to cave-in, another owing to breakdown of the pumping equipment, and the fifth when mud formed at the bottom of the hole and the line pressure was insufficient to wash the mud to the surface.

The remaining two holes were drilled to depths of 307 ft. and 453 ft. respectively. Thermistor elements were lowered into each of these and regular temperature readings are being taken. The 453-ft. hole was completed in four days. A greater depth could have been reached; but so much drilling equipment had