

Earth's Attraction Being Measured

Physics

Accurate Figures Will Aid Prospectors and Surveyors

EXACT determination of the force of the earth's attraction now in progress at the U. S. Bureau of Standards will make the United States independent of Germany in a few years in knowledge of how hard the earth pulls things toward it. Speaking in a Science Service radio talk over the Columbia Broadcasting System, Dr. Paul R. Heyl told of the work, which is under his charge. Dr. Heyl's determination during the last few years of the "constant of gravity," from which scientists calculate the mass, or "weight," of the earth, is the most accurate that has yet been made.

The new measurement of the absolute value of gravity is being made to an accuracy of within one part in a million. It will help the surveyors of the Coast and Geodetic Survey to map the country more accurately than ever before.

"The surveying of large areas differs from small scale work in that the curvature of the earth must be taken into account," Dr. Heyl explained. "It is not sufficient to assume that the surface is spherically curved, even on the Great Plains. One of the best ways of determining the change of curvature of the earth's surface is by the variation in the pull of gravity at different places. Where we are farther from the earth's center, the pull is less. But since such departures from spherical form are always very small compared to the size of the earth, we must be able to measure gravity very accurately indeed if the results are to be useful.

"Determinations of gravity are made throughout the United States on a comparative or relative basis, with reference to a base station, where the value of gravity should be known to as high an accuracy as possible. While it is a comparatively simple matter to compare different values of gravity with one another it is quite another thing to determine the absolute value of gravity at the base station.

"It happens that our Coast Survey has never had a real base station for gravity in this country. The measurements throughout the land have been compared, it is true, with the value of gravity at Washington, but the value at Washington traces its pedigree from the absolute gravity station at Potsdam in Germany. It is by no means as simple a matter as it appears to extend comparisons of gravity across the ocean, and without a base station of our own we are not quite sure of our ground. The experiments now in progress at the Bureau of Standards are for the purpose of establishing such a base station in our own country."

One very practical use of gravity measurements is in locating valuable deposits of oil and minerals.

"The pull of gravity may vary be-

cause of the nature of the material beneath the surface at different places," he said. "Perhaps there may be underground a large body of rather heavy rock, or again there may be a deposit of oil, very much lighter than the average crust of the earth, and consequently less attractive (from a gravitational point of view). Many an oil well has been discovered in this way; but it will be obvious that if the deposit is very deep it will require great precision in our gravity measurements to detect its presence.

"How is the pull of the earth measured? There are several ways in which it can be done more or less roughly, such as by the use of a spring scale, or by measuring the speed attained by a falling body, but the most precise way is by means of a pendulum.

"A pendulum swings because of the earth's attraction. Draw its bob to one side and release it; the earth tries to draw it vertically downward, but being rigidly connected to its point of support the only thing the bob can do is to move downward along a circular path. At the bottom of its swing, having acquired considerable momentum, it rises along another arc of a circle, gravity acting against it all the while, and eventually bringing it to rest. The cycle of motion is then repeated.

"The time of swing of a pendulum is determined by two things: the force of gravity and the length of the pendulum. Consequently, if we measure the length of the pendulum and determine its time of swing we can calculate the value of gravity.

"Both these measurements of length and time are capable of being carried out with a high degree of precision, and in consequence no other method of determining gravity can approach the accuracy of the pendulum. But to ensure precision many precautions must be taken.

Science News-Letter, April 12, 1930

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SCIENCE NEWS-LETTER, The Weekly Summary of Current Science. Published by Science Service, Inc., the Institution for the Popularization of Science organized under the auspices of the National Academy of Sciences, the National Research Council and the American Association for the Advancement of Science.

Edited by Watson Davis.
Publication Office, 1918 Harford Ave., Baltimore, Md. Editorial and Executive Office, 21st and B Sts., N. W., Washington, D. C. Address

all communications to Washington, D. C. Cable address: Scienserve, Washington.

Entered as second class matter October 1, 1926, at the postoffice at Baltimore, Md., under the act of March 3, 1879. Established in mimeographed form March 13, 1922. Title registered as trade-mark, U. S. Patent Office.

Subscription rate—\$5.00 a year postpaid. 15 cents a copy. Ten or more copies to same address, 5 cents a copy. Special reduced subscription rates are available to members of the American Association for the Advancement of Science.

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