SCIENCE NEWS

WEIGHING OF A CRYSTAL TO TEST THE EINSTEIN THEORY

Science Service

A BALANCE so delicate that it will weigh three pounds with an error of not more than one part in a billion is being used by Dr. Paul R. Heyl, of the Bureau of Standards, in experiments to prove the truth or falsity of the Einstein theory with regard to gravitation. It is the most accurate weighing that science has ever successfully attempted. The results so far are all in favor of Einstein, but are only one fifth completed.

The method involves the weighing of large crystals in varying positions. The largest topaz in the world borrowed from the United States National Museum was one of those used. To obtain results of value the utmost refinement of accuracy was necessary, and to those unacquainted with what a scientist means by that expression, a visit to the laboratory where the work was done would be illuminating. The proverbial princess of the fairy story who felt a crumpled rose leaf under sixteen feather beds was not more sensitive than the balance used in this work.

It is of the general type of chemical balance used for weighing relatively large quantities, but fitted with every latest appliance to avoid error. No human hand comes anywhere near it when it is in use. The crystal to be weighed is first placed in the required position in a sort of frame connected with a series of rods proceeding from the balance case and extending through a brick wall about six feet away. It is then weighed to what would be called extreme accuracy by the experimenter standing in the balance room and putting in the heavier weights by hand. But that is all merely preliminary to the main show.

The whole balance is then encased in movable walls of cork composition about two inches thick, leaving just room enough for the control rods and for the reflection of a beam of light from a lamp outside the chamber wall to shine through and onto a mirror, the swings of which measure the final balancing. The experimenter then leaves the room which is closed tightly with a double door and left to come to a uniform temperature.

This takes nearly an hour, after which the room does not vary one tenth of a degree from one part to another. It is most important that the two arms of the balance shall not vary in temperature by more than one thousandth of a degree, as this would introduce into the experiment an error of one part in several million, which would ruin its value. The weighing is then made by the operator sitting outside the brick wall and controlling the final delicate weights with the rods projecting through it.

One of the refinements introduced is the use of weights equal in volume to the crystal and supporting frame. The weights and the crystal both displace air as substances sunk in water displace water. If they differed more than two or three per cent. in volume the varying amount of air displaced would introduce a serious error.

Another refinement is to keep the center of gravity of the crystal to be weighed at the same level. The farther from the earth the less the force of gravity, and although an object would have to be carried miles up in the air before it would lose an appreciable part of its weight, a change of less than half an inch would be detected by this balance.

According to all the theories of gravitation from the time of Newton to Einstein, it is caused by some sort of mechanical stress either in the nature of a pull or a push upon the things mutually attracted. If this were true, it is expected that crystals would be attracted more or less to the earth and would vary in weight according to the position in which they are placed, for in a crystal the atoms all lie the same way in a sort of lattice formation, and the amount of resistance they would offer to the impact or pull of gravitation would vary according to the way they were placed.

Einstein says, on the contrary, that gravitation is like the force exerted on a string by a whirling object tied to it; and that it is due to a whirling of the four dimensional universe, which he assumes, in an additional fifth dimension. Dr. Heyl's experiments so far show that Einstein is right. If he really is, there is no cure for gravitation except to iron out the four and five dimension curves which he assumes, or to stop the whirling. Dr. Heyl offered no solution to these problems which Einstein admitted in a recent reported interview could not be expressed in words.

THE CAHOKIA MOUNDS

Science Service

THE famous Cahokia mounds, lying in the rich American bottoms not far from the junction of the Missouri and Mississippi rivers and near East St. Louis, Illinois, are the remains of the largest prehistoric city in the United States, W. E. Myer, archeologist, declared on his recent return here

from a visit to this site, which is now being excavated by Professor Warren K. Moorehead, curator of the department of archeology of the Phillips Academy, Andover, Massachusetts, under the auspices of the University of Illinois. Unless action is soon taken to preserve these great mounds, he said, the rapid spread of modern factories in the outskirts of this important manufacturing Illinois city may completely efface the ruins of this ancient Indian metropolis, which exceeds in size any other city occupied by prehistoric man in the United States.

The University of Illinois and also a large number of prominent men throughout Illinois and the adjoining states are very much alive to the importance of having an experienced archeologist like Professor Moorehead to explore carefully and study these great mounds. There is now a bill before the Illinois legislature to appropriate sufficient money to purchase the site of this ancient city and to set it aside as a state park for the pleasure and education of our people forever. They feel that to allow these great mounds to be destroyed would be almost a crime against future generations.

There are eighty mounds in this great Cahokia group, scattered over an area of about two thousand acres; but the extreme limits of this old city are still unknown. The largest of these mounds, known as the Cahokia mound, is by far the largest ever raised by prehistoric races within the boundaries of what is now the United States. This mound is about 998 feet long, 710 feet wide and rises above the surrounding country to a height of over 90 feet.

These vast earthworks probably at one time contained on their summits temples and chiefs' houses and other important structures.

No accurate estimate can as yet be made as to the date when the mounds were erected or the number of people required to build them. Some of the smaller mounds in this group may possibly be burial mounds, as modern Indians have been known to raise mounds over the bodies of some of their powerful chiefs or over large numbers of their less important dead.

Several years will be required to complete the exploration of these ruins. Although they have been known to white men for over two hundred years, there has been little intensive exploration of them until the University of Illinois expedition under Professor Moorehead began work in 1921. It is hoped that this expedition, which is now in the field, will unearth sufficient evidence to enable them to determine what ancient Indian tribe erected these great mounds and lived in this large city.

The builders of these mounds were not a separate race, Mr. Myer added, but were our ancient American Indians. These mounds have been called the Cahokia group because the Cahokias, a small tribe of a few hundred Indians, were found living in the vicinity when the first white explorers came into the region. The Cahokia Indians did not live upon these mounds. They did not and could not have built the ancient city. The Cahokias stated that they found these great ruins of a vanished tribe lying silent and deserted when they first came into the region. No one could tell them who built them, or when or why the vast population perished or departed.

WEATHER FORECASTS AT SEA

Science Service

THE extension of the daily weather forecasts to cover the entire North Atlantic ocean is characterized as an imminent development of meteorology by Major E. H. Bowie, chief forecaster of the United States Weather Bureau, who has recently returned to Washington after a round trip to France on the French merchant training steamship *Jacques Cartier*. The trip was undertaken under the direction of Professor C. F. Marvin, chief of the United States Weather Bureau, to determine the feasibility of making daily weather maps and forecasts at sea, and, according to Major Bowie, was a complete success. Forecasting at sea is entirely practicable, he says.

The trip over and back lasted about six weeks and every day of that trip the forecaster was able to make a morning and night weather map showing conditions over the whole North Atlantic, western Europe and the whole United States and Canada. Reports were received by radio from vessels at sea, from the Navy station at Arlington, and from the French station at the Eiffel Tower.

Forecasts for the whole ocean between the tropics and the latitude of Iceland were made and broadcast every day from the *Jacques Cartier* at noon, Greenwich time. The reports from vessels were relayed to Europe and to America, where they were of great value to forecasters there through informing them of storms which were on their way across the ocean.

"There was no difficulty in getting enough vessels to furnish us with data," Major Bowie said. "They were anxious to cooperate and fairly hungry for the forecasts. This was true even of the big liners which hold their courses irrespective of the weather. They wanted to know what they had to face."

The forecasts were made for the principal steamer tracks, such as from the Azores to Ber-

muda or Gibraltar or Great Britain, or from north European ports to Newfoundland and New York. Special warnings of the approach of storms of unusual intensity were given.

It is entirely practicable to put out daily forecasts at sea and to broadcast them by radio for hundreds of miles. "It would be inexpensive if the principal maritime nations cooperated. Experienced meteorologists and forecasters could be distributed on vessels so that one or two would always be at sea. They would receive the reports from other vessels and from land stations, get up the daily forecasts and broadcast them, and relay the vessel reports to land where they would be of great value. The weather of the ocean can be charted just as easily as that on the land, with results of great value both afloat and ashore. It is a field of work which has been greatly neglected and its development will be the next forward step taken in meteorological science."

BRAIN CELLS UNHURT BY RAYS THAT KILL TUMORS

Science Service

A CLUE to the mystery of cancer, of possibly great importance, has been discovered by scientists at the Memorial Hospital for the Study of Cancer and Allied Diseases, who have found that while X-rays and radium rays have a destructive effect upon tissue cells, especially on the cells of cancer tissue, the cells of the brain are more resistant to their action than those of any other part of the body. Brain cells and cancer cells stand at opposite ends of a scale of susceptibility to the invisible rays.

The immediate practical bearing is in the treatment of brain tumors, which because of the delicate construction of the vital brain tissues which surround them, are frequently inoperable surgically. They may now be treated by X-rays or radium rays, as a treatment strong enough to damage the tumor or cancer is not injurious to the brain tissues through which the rays also pass. While X-ray treatment always has the danger of damage to healthy tissue, it has now been shown that such treatment of growths in the brain may be carried on with a wider margin of safety than is possible in other parts of the body.

The work at the hospital has been carried on chiefly with radium. The institution has one of the largest supplies in the United States; four grams of the precious metal having been given the hospital in connection with a laboratory for its use by the late Dr. James Douglas.

The three sorts of radium rays, known as alpha, beta and gamma rays, vary in their penetrating power and destructiveness, the alpha being the most destructive, but the least penetrating. The alpha rays are accordingly filtered out by screens of platinum through which the gamma rays pass to exert their effect in the interior of the brain. In some cases the radium emanation which gives off the rays is enclosed in platinum-cased glass capsules and inserted directly into the brain tissue, the capsules being sometimes as small as an eighth of an inch in diameter.

Explanations of the comparative resistance of the healthy brain tissue to the effect of the rays which are destructive to tumor or cancer cells, and to a less extent to other body tissues, are being sought, as it is thought they will have an important bearing on the problem of what causes cancer.

WATER POWER PLANTS GIVEN NEW IMPETUS BECAUSE OF COAL SITUATION

Yale University News Statement

ACCORDING to Arthur T. Safford, consulting hydraulic engineer of Lowell, Massachusetts, who is giving a course of lectures on water conservation at Yale, many water power plants are being developed as a result of the acuteness of the coal situation. In New York state the production of electricity during the last ten years has more than doubled, while the use of coal has increased but 50 per cent. Instead of cheap coal, cheap water power is building up the Pacific coast and the south, and is one reason for New England's remaining an industrial center. New England has seen her comparatively small total water power of ten years ago more than doubled through the construction of hydrostations of the Central Maine Power Company, New England Power Company, Turners Falls Power and Electric Company, and the developments in the great textile cities of Lowell, Lawrence and Holyoke, Massachusetts, and Manchester, New Hampshire.

New York state is developing water power from the Barge Canal, and Henry Ford is making an interesting development at the state dam at Troy, New York. Installations of water power, and most of it of the most modern kind, increased from 4 million in 1912 to 8 million developed horse power in 1921.

The recent construction of the New York City and Los Angeles, California, water supplies, the flood control work of the Ohio River Valley, the Ripogenus storage of the Great Northern Paper Company, Maine, and the very recent Dead River storage of the Upper Kennebec River in Maine are interesting examples of water storage which will be followed by studies for similar water supplies and water storage on many of our streams.

Many power and storage projects are being built abroad, one in South Africa called the Lake Mentx Conservation Works along the lower reaches of Sunday's River. The dam impounds 25,700,000,000 gallons of water and submerges 4,900 acres. This dam will furnish water for intensive cultivation for about 40,000 acres in the Sunday's River valley. France with only 930,000 horse power of hydro-electric power in 1913 was producing some 2,100,000 horse power in 1921 and many new projects are being studied.

In spite of all the developments in Canada, it is said that 94 per cent. of the water power is idle, and some one has estimated the total water power of Canada at 41,700,000 horse power.

One of the greatest water storage and water supply projects abroad which has been built and operated for industrial and water supply purposes, and built at a greater cost than has been thought economical for this country, is in the Ruhr region of Germany.

New England, although alive to the needs of power, has been surpassed by the great developments at Niagara Falls on both American and Canadian sides, the Mississippi River at Keokuk, and the high head developments of the Pacific coast. Formerly a hydro-electric development was made in advance of transmission lines and a market; now the transmission lines often become the feeders for power sold at wholesale by more than one company. Like the railroads, they are reaching out in all directions, but for power rather than customers.

NEBULAE IN THE SOUTHERN SKIES

Harvard News

NEW light is thrown on the number and distribution of nebulæ in the southern skies by the discovery by Harvard astronomers of no less than 850 nebulæ on a single telescopic photograph, covering an area of about 30 square degrees, taken at Arequipa, Peru, according to a bulletin issued by the Harvard College Observatory.

The photograph was made at the Harvard astronomical station at Arequipa on September 19, 1922, with the powerful 24-inch Bruce telescope with an exposure of six hours. The new nebulæ, discovered at Cambridge when the plate was shipped here for examination, "are not of the nature of the faint irregular nebulous wisps frequently found in the vicinity of bright spirals," says the bulletin. "Rather, they are distinct nebulæ, the fainter ones almost exclusively oval or circular in form. . . . The brighter nebulæ, almost without exception, are elongated, or show spiral structure, while the fainter appear to be largely globular."

The announcement recalls the discovery last summer of two thousand nebulæ on ninety earlier photographs made at Arequipa with the same telescope. Much less is known to date about the southern than about the northern nebulæ, and these investigations are being pursued in order to supplement the very incomplete data possessed by astronomers.

"It is generally believed," states the observatory bulletin, "that the northern galactic hemisphere is richer than the southern in nebulæ of the spiral family. For the spirals and spindles brighter than the tenth magnitude this belief apparently is justified; but it may depend to some extent on the incompleteness of the surveys of the southern sky. We know little as yet concerning the distribution of the fainter nebulæ of this class, except that they are relatively infrequent near the galaxy (or milky way) and that there is a tendency to form loose clusters."

ITEMS

SUNSPOTS have no determinable influence on the temperature of the United States as a whole, according to Professor Alfred J. Henry, of the United States Weather Bureau, who spoke before the American Meteorological Society in Washington on April 16. He spoke on the results of a study of sunspot frequencies and temperature deviations in this country for more than a hundred years. The years of minimum sunspots coincided with years of general high temperature in five out of ten cases, there was a negative fluctuation in three cases and exactly normal temperature in two. On the other hand, the years when there were the greatest number of sunspots were usually cold in five cases and unusually warm in an equal number. Evidence was found of the existence of short temperature cycles of irregular length, warm and cold years sometimes alternating and at other times occurring in groups of 3, 4 or 5 years. It is difficult, the speaker said, to connect these directly with changes in solar radiation, stating that it was difficult, if not impossible, to disentangle the network of influences which produce fluctuations in terrestrial temperature changes, and that it was hopeless to look for effects of temperature changes from solar radiation in the case of the northern states east of the Dakotas.

ONLY two centuries ago beavers inhabited the greater part of the North American continent and were an important source of food and warm clothing to the natives.

FULLY 30,000 California gray whales, a species now commercially extinct on our western coast, visited California waters annually only fifty to seventy years ago.