

PHYSICS

New Apparatus May Double World's Record High Pressure

"Cascade Bomb" Apparatus May Eventually Produce Pressure Equal to That Inside Earth 745 Miles Deep

SCIENTISTS stand at the threshold of experiments which should enable them to duplicate pressures encountered 745 miles down inside the earth, and double present world's record pressures of 3,000,000 pounds to the square inch and over.

The record high pressure, equaling pressures more than 100 miles within the earth, has just been obtained by two scientists of the Carnegie Institution of Washington, Dr. Roy W. Goranson of the Geophysical Laboratory and Ellis Johnson of the Department of Terrestrial Magnetism with a "cascade bomb" apparatus. Their results virtually duplicate the high pressure of 3,000,000-3,500,000 pounds per square inch reported (*Physical Review*, Feb. 15) by Prof. P. W. Bridgman of Harvard University. (See *SNL*, March 9.)

Limited By Gauge

The only reason the Carnegie experiment was stopped at 3,000,000 pounds per square inch, or 200,000 atmospheres, was that the pressure gauge used was not calibrated beyond that point. The pressure equipment itself potentially may be capable of doubling this pressure. If this can be done, it will produce a pressure equal to that inside the earth at depths of 745 miles and permit important studies of the properties of matter at these pressures.

Announcement of the Carnegie's new cascade bomb equipment was a dramatic highlight of the Conference on Theoretical Physics which is sponsored annually by the Carnegie Institution and George Washington University. The theory which led to the construction of the apparatus will be presented in *Journal of Chemical Physics* (April). The distinguished scientists present heartily applauded the new high-pressure achievement which was performed in an intensive all-night research by Dr. Goranson and Mr. Johnson.

It was at this same conference, just a year ago, that the dramatic announcement was made to America that science had found a way to split uranium atoms

with neutrons and make them yield enormous amounts of atomic energy.

Secret of the amazing pressures attained by the Carnegie experimenters is the use of cascade bomb apparatus. This device consists of two pressure chambers arranged one inside the other so that the inner one is surrounded with a kerosene-like oil known as varsol under a pressure of 17,000 atmospheres, or 255,000 pounds to the square inch.

Under this low pressure (low only by comparison) the steel walls of the small, inner pressure chamber are tightly squeezed on all sides and the steel of the chamber appears to take on greatly increased strength. This extra strength permits a tiny plunger inside the inner chamber to be forced inward with a total pressure of 3,000,000 pounds to the square inch.

Under ordinary conditions the steel chambers would probably not be able to withstand pressures of much more than 600,000 pounds per square inch.

It is inside the inner pressure chamber that the sample is placed which is subjected to the 3,000,000 pounds pressure.

Table Salt Used

Dr. Goranson and Mr. Johnson, in their tests, used ordinary table salt, sodium chloride. They found that at the extreme pressure it was squeezed so tightly its volume was decreased by 20%, or one-fifth. This means, it is explained, "that the space inside the sodium chloride molecule was mostly eliminated by the pressure, so that the atoms making up the molecules of salt actually, or nearly, touched one another."

Contrary to some other chemical substances which have been studied under high pressures previously, the salt used in the Carnegie tests appears to have suffered no color or structural change.

The new apparatus will greatly extend the pressure ranges over which scientists can study the behavior of many materials.

It is already known in chemistry that the speed of some reactions can be increased by pressure. Pressures up to



FOR RECORD PRESSURES

Dr. Roy W. Goranson (left) examining the apparatus he designed with Ellis Johnson at the Carnegie Institution's Department of Terrestrial Magnetism for producing the world's highest pressure. L. H. Adams, director of the Geophysical Laboratory stands at the right.

1,000 atmospheres—15,000 pounds per square inch—are used in chemical syntheses.

It would be theoretically possible, although quite costly, to extend the ability of the cascade bomb by housing the two pressure chambers within still another chamber. The ultimate pressure which could be created in this way would be limited, Dr. Goranson said, only by the pressures at which the steel walls of the innermost chamber would finally reach a state of plastic flow. While the scientists cannot guess this pressure, it is known to be extremely great.

It is possible that with extreme pressures scientists will be able to bring about changes in matter which are believed to have occurred deep within the earth at the tremendous pressures there encountered. At the center of the earth, it is estimated, the pressure is 3,500,000 atmospheres or over 52,000,000 pounds per square inch. Even with 3,000,000 or 6,000,000 pounds per square inch pressures, science will be a long way from this figure, but every increase adds knowledge about one of science's major mysteries—the internal constitution of the earth.

Science News Letter, April 6, 1940