PHYSICS

# Measurement Standard

**Transmutation of gold into mercury in the cyclotron has produced a standard which is ten times as accurate as the one now accepted.**

➤ BY THE TRANSMUTATION of gold into mercury in the cyclotron—a reversal of the alchemists' dream—University of California scientists have produced a standard for the measurement of length which is proving itself to be ten times as accurate as the one now accepted.

The standard for measurement is a spectrum line—at present a red light ray produced by making the atoms of cadmium glow.

The new standard is a sharp green light ray produced by exciting the atoms of the transmuted mercury in a quartz tube with a high frequency radio beam until they give light.

Measurements can be made with the green light ray with an accuracy of billionths of an inch. The standard of measurement is used in the grinding of lenses and prisms, in the testing of nearly all optical equipment, and in a vast number of scientific experiments requiring precise measurements.

The special type of mercury made from gold is the isotope, or "sister", in the mercury family with the atomic weight 198. It is produced by bombarding gold atoms with neutrons. The gold atoms "capture" neutrons, becoming radioactive, and, after emitting electrons, turning into mercury 198.

Ordinary mercury has a number of isotopes, and when it is made to glow each isotope emits a slightly different light, much as there are a number of different notes in a chord played on a piano. A spectroscope separates the light into its component parts, a light ray being present for each isotope.

Gold is transmuted into mercury 198 of such purity that less than one atom in a million is other than mercury 198. Therefore the sharp green line of mercury 198 is produced with great clarity and sharpness, undiluted by the light of other mercury isotopes, much as a single note on a piano is struck. Its wave length does not vary by more than one fifty-billionth of an inch.

About five milligrams—half a cent's worth—of gold is used in the transmutation of enough mercury to make a "lamp" for mercury measurement standard. The Berkeley scientists estimate that hundreds of thousands of times as much mercury 198 could be produced by using the "pile" technique used in the atomic bomb project as can be produced in cyclotron bombardment.

The superiority of the mercury measurement to that of cadmium is due partially to the fact that mercury atoms are heavier and can be made to glow at temperatures below freezing. Heat makes atoms move faster, and lighter atoms move more than heavy ones. The lightness of cadium atoms plus the fact that they must be heated to 300 degrees centigrade to produce the red light ray result in a fuzzier line than the mercury ray.

The cadmium standard of length was adopted in 1893 as the primary standard of length, and had not been improved on until the mercury ray was produced. The Berkeley scientists believe it will be possible to produce a mercury "lamp" which can be plugged into a 110 volt alternating current outlet. This is much simpler than the cadmium equipment, which requires a furnace.

Mercury for a dozen lamps has been produced in cyclotron bombardments. Several lamps have been sent to the Bureau of Standards for experimentation, some have been sent to the Eastman Kodak Company, while others are used in university laboratories.

Transmutation of gold into mercury 198 was accomplished by Dr. Jacob H. Wiens, now a staff engineer of the U. S. Electronics Research Laboratory on the Berkeley campus, and Dr. Luis Alvarez, professor of physics and one of the nation's leading young atomic scientists.

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PHYSICS

## "Baby" Betatron Produces Inexpensive Radiations

➤ RADIATIONS equal to three grams of radium are produced at one-tenth the cost of radium by a four-million volt, "baby" betatron built at the University of Illinois.

Smaller and simpler than the push-button controlled 20-million volt betatron, the new device is expected to be used for X-ray work in science and industry.

"It can be used in place of radium for taking X-rays, but has the advantage of an initial cost only one-tenth that of the radium to produce equal energy," declared Prof. Gerald M. Almy, who headed work on the new betatron.

The new machine is safer than radium, and concentrates its beam in one direction instead of all directions. Sharper X-ray pictures result from the betatron's pin-point beam that is more intense than any useful amount of radium, according to Prof. Almy.

Lone disadvantage reported was that the new betatron requires an operator in charge while it is running, where radium, once it is placed, requires no further attention.

The four-million volt device for science and industry consists of an electromagnet, 15 inches wide, 25 inches long and 8 inches high, mounted on a wheeled frame and arrranged so that the beam can be swung up or down. The voltage is generated from a doughnut-shaped ceramic tube 8 inches in diameter that is located inside the hollow of the rectangular electro-magnet.

Electrons released from a glowing filament in the tube are accelerated by magnetic force and hurled against a tiny ray-creating target.

The power unit, connected to the magnet by a flexible cable, is kept at least ten feet from the betatron during operation, a safe distance for the operator whose control panel is on the power unit.

Prof. Almy claims the design is so simple that any laboratory machine shop can build a "baby" betatron, three of which have been built at Urbana and at least one other, made from the same plans, has been constructed at Ohio State University.

University of Illinois scientists are now working on a giant, 250-million volt betatron expected to produce cosmic ray effects.

Built during the war, the new betatrons were produced under the auspices of the Office of Scientific Research and Development.

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*E600* is a German insecticide developed during the war; some claim it is better than DDT.

There are about 300 varieties of *olive trees* from which olives and olive oil are obtained; the oil content depends not only upon the variety but upon soil and climatic conditions.