prepared the first sample in pure form by going through the plutonium iodate and the hydroxide, etc., on to the oxide.

This 2.77-microgram sample was weighed on September 10, 1942 (Figure 7). The first aim was to weigh it with a so-called Emich balance, which was somewhat complicated and had electromagnetic compensation features. As it turned out, owing to the heavy load in the shops, this weighing balance would have taken perhaps six months to build.

Cunningham then had the idea of using a simple device consisting of a quartz fiber about 12 centimeters long and 1/10 of a millimeter in diameter suspended at one end with a weighing pan hung on the other end. Then the depression of that end of the fiber with the pan containing the sample would relate to the weight of the sample. Cunningham measured the depression of the quartz fiber with a telescope. He built this balance himself, although he found out later that an Italian named Salvioni invented it earlier, and so it became known as the Salvioni balance. A description of this first isolation and first weighing of plutonium was published by Cunningham and Werner (11) after World War II.

The chemical separation (extraction) process that finally evolved had three stages: (1) the separation from uranium (extraction) and from the fission products (decontamination) used oxidation-reduction cycles with bismuth phosphate as the carrier precipitate; (2) the concentration (volume reduction) step used an oxidation-reduction cycle with rare earth fluoride as the carrier precipitate; (3) the isolation step consisted of the precipitation of pure (carrier-free) plutonium peroxide from acid solution. There was widespread concern that bismuth (III) phosphate would not carry plutonium (IV) quantitatively at the concentrations that would exist in the chemical separation plant. The critical experiments on the ultramicro-chemical scale showed that plutonium (IV) phosphate is carried completely (>95%) at these concentrations. The so-called Bismuth Phosphate Process operated very successfully in both the plutonium pilot plant at Oak Ridge, Tennessee, and the production plant at Hanford, Washington.

The Revised Periodic Table

At this time we thought that the transuranium elements had the same kind of relationship as the rare earths--a new group of rare earths--and there should be 14 of them, with uranium as the prototype. This we would call the uranide series, just like the lanthanide series. It was on this basis that we predicted that element 95 and element 96 would be chemically like plutonium, neptunium and uranium--a little different, but more or less the same. Wrong again! We were just slow learners; we had to proceed by making mistakes. When we tried by transmutation reactions to produce elements 95 and 96 by this method and to identify them chemically, we could not do it.