between adjacent Ni^{61} hyperfine lines was 10.5 gauss.

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[1]G. W. Ludwig and H. H. Woodbury, Bull. Am. Phys. Soc. Ser. II, 3, 135 (1958).

[2]Obtained from Isotopes Sales Department, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

[3]W. W. Tyler and H. H. Woodbury, Bull. Am. Phys. Soc. Ser. II, 2, 135 (1957); Tyler, Newman, and Woodbury, Phys. Rev. 98, 461 (1955).

ATTEMPTS TO CONFIRM THE EXISTENCE OF THE 10-MINUTE ISOTOPE OF 102†

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In many score of experiments conducted in various ways over a period of many months we find that we are unable to confirm the element-102 discovery work of Fields et al. reported in 1957.[1] These experimenters ascribed to an isotope of element 102 an alpha particle activity having an energy of 8.5±0.1 Mev and a half-life of approximately 10 minutes. It was reported to be produced by bombardments of a 1 mg/cm² curium target with 0.03 - 0.10 microamperes (meter current) of C^{13} ions of about 90 Mev energy in the internal beam of the Nobel Institute 225-cm cyclotron.

Our attempts to reproduce this activity were made with the monoenergetic ion beam available from the Berkeley heavy ion linear accelerator (HILAC). Curium with a similar isotopic composition was used, except that instead of one target we used six separate electroplated targets, four with 0.4 mg/cm² curium and two with 0.1 mg/cm² curium. These were mounted in vacuum so that the heavy-ion beam could pass through and knock the transmutation recoils into 0.9-mg/cm² palladium foils. After a suitable bombardment the six catcher foils were dissolved in a few drops of concentrated aqua regia and an actinide-element fraction quickly separated from palladium by elution with 2 M HCl from a column packed with Dowex-1 anion exchange resin.[2] It was possible to examine a transplutonium fraction within 8 minutes from the end of bombardment. A wide range of energies (60 - 100 Mev) of both C^{12} and C^{13} projectiles and (+6) ion currents up to 0.2 microamperes were used. In order to compare these bombardments with those which were reported to have produced the 8.5-Mev alpha activity one can compare the amounts of the other alpha particle activities that are produced in such bombardments. The nuclides Fm^{250}, Cf^{245}, and Cf^{246} were found in far greater amount in our experiments than in the aforementioned cyclotron runs. In the case of Cf^{246}, for example, which is produced with a relatively flat excitation function, we found in a typical experiment about 40 alpha counts per minute. This should be compared with 0.1 alpha counts per minute of Cf^{246} found in the cyclotron experiment which was reported to have yielded four 8.5-Mev events. This comparison would indicate that we should have observed at least 100 such events in each experiment since the ratio of the 8.5-Mev, 10-minute activity to that of Cf^{246} should have remained approximately the same in our experiments. We observed no pulses in this energy region that could not be attributed to background, namely, a total of a few counts spread over dozens of experiments.

Since it was thought to be remotely possible that perhaps the element 102 activity was being volatilized out of the palladium catchers preferentially compared to the other activities, experiments were also performed in which the recoil atoms were caught in helium-cooled "Mylar" films (ca 1 mg/cm² thick). After bombardment the Mylar foils were flamed on a platinum plate and alpha-pulse-analyzed within less than one minute from the end of irradiation. Still no other unknown activity was seen even though, as before, large amounts of californium and fermium activities were produced.

After the development of the electrostatic recoil collection method and its successful application to the search[3] for element 102 we again looked carefully for new short-lived high-energy alpha emitters. The recoil atoms were caught on negatively charged aluminum foils in helium and examined directly 30 seconds from the end of bombardment. C^{12}, C^{13}, and also O^{16} projectiles were used over a range of energies from 60 to 145 Mev but without success in seeing any long-lived, 8.5-Mev alpha-particle emitter.

These bombardments, made with 0.25-microampere beams (meter current) did, however, at the same time produce large amounts of californium and fermium activities and were otherwise quite similar to those experiments with the moving belt in which we identified the 3-second nuclide 102^{254}.[3]

The data arguing against the validity of the Stockholm experiments on which the claim to the discovery of element 102 was based may be summarized as follows:

1. We have used curium targets with substantially the same isotopic composition and have bombarded them with C^{13}, C^{12}, and O^{16} ions over a wide energy range with monoenergetic beam currents as much as ten times greater than those of wider energy spread in the cyclotron experiments. We have used three different methods of handling the transmutation recoils from the targets; all of them were successful in that we detected large amounts of other actinide element products but nevertheless failed to produce the 10-minute, 8.5-Mev activity. That our experiments should have detected this unknown activity is made certain by the fact that one of these methods (electrostatic collection of target recoils) was used in the identification of a very short-lived isotope of element 102.

2. Our inability to confirm the Stockholm results we feel may possibly be explained by the following circumstances. The cyclotron experiment, because it had to make use of the internal beam, was an extremely difficult one to perform. The amount of activity produced varied erratically but was always very tiny; not more than a few events in any one experiment were ever seen, and in most of them none was detected. Under these trying conditions it was apparently not possible to make sure that the unknown activity could not be ascribed to a light element impurity or other artifact. In connection with this it should be noted that the one crude ion-exchange elution experiment performed showed the unknown activity to elute immediately after the free column volume, and thus did not provide a clear chemical differentiation from several possible lighter elements. It should also be noted that at the 90-Mev C^{13} energy used most of the time in the cyclotron experiments one would produce predominantly those neutron evaporation reactions where six or more neutrons would be emitted. This would limit the mass number of any isotope of element 102 that could be produced to 253 or less. It is quite conceivable that some isotope of 102 such as 102^{257} or 102^{259} could have a half-life of ten minutes, but these could only be produced by bombardment of heavier curium isotopes, even when using lower energy bombarding ions. It would also be expected that a 10-minute half-life for an isotope of element 102 would imply an alpha-particle energy for the most abundant group closer to 8.0 than to 8.5 Mev.

The only conclusion that we can draw from these observations is that the activity found by these experimenters cannot be ascribed to element 102.

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[1]A. R. Fields et al., Phys. Rev. 107, 1460 (1957).

[2]K. A. Kraus and F. Nelson, Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, Geneva, August, 1955, (United Nations, New York, 1956), Vol. VII, p. 113, P/837.

[3]See Ghiorso, Sikkeland, Walton, and Seaborg, following Letter [Phys. Rev. Lett. 1, 18 (1958)].

ELEMENT NO. 102 †

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By the use of a radically new method[1] we have succeeded in identifying unambiguously an isotope of element 102. In other careful experiments[2] conducted over a period of many months we find that we are unable to confirm the element 102 discovery work of Fields et al. reported in 1957.[3]

The experiments at Berkeley were performed with the new heavy ion linear accelerator (HILAC) over a period of several weeks and culminated in the chemical identification of an isotope of fermium (Fm^{250}) as the daughter of an alpha-particle-emitting isotope of element