The author acknowledges with pleasure his indebtedness to Professor S. W. Barnes for suggesting this experiment, which was carried out under his guidance. He also wishes to thank the engineering and shop staff under the direction of Messrs. Richard Mortenson and Hugo Logemann, the cyclotron operating crew under the direction of Mr. Fred Palmer, and Messrs. Cecil Angell and John Perry for able assistance with the experiment.

* This work performed under the auspices of the AEC.
[1] W. J. Knox, Phys. Rev. **81**, 693 (1951).
[2] R. E. Marshak, *Meson Physics* (McGraw-Hill Book Company, Inc., New York), Chapter III (to be published).
[3] R. Littauer and D. Walker, Phys. Rev. **83**, 206 (1951).

Nickel 56*,†

W. J. WORTHINGTON, JR.‡
Radiation Laboratory and Department of Chemistry, University of California, Berkeley, California
(Received March 10, 1952)

IN the course of an investigation of the high energy spallation products of zinc,[1] evidence for the existence of a new isotope of nickel was obtained. In order to isolate and identify this new nickel activity, zinc target foils were bombarded with 340-Mev protons for approximately two hours. The nickel fractions were not isolated until approximately twenty days after bombardment, in order to allow most of the Ni^{57}, Ni^{65}, and Ni^{66} to decay prior to chemical separation. One of the final steps in chemical purification consisted of adding inactive cobalt to the isolated nickel fraction and separating the nickel and cobalt through the use of an anion exchange column. This method, originally developed by Diamond and Hollander,[2] consists of passing a concentrated hydrochloric acid solution of the activities through a column of Dowex-A-2 resin. Cobalt and other elements which form chloride complex ions adhere to the resin while nickel passes through with the elutriant. The chloride complex ions may be eluted with dilute hydrochloric acid. The cobalt was recovered and checked for activity, the absence of which indicated that no cobalt activity was in the nickel sample at the end of chemical purification. After the decay of the nickel sample had been followed with a Geiger counter for approximately eighteen days, cobalt was again separated chemically. The cobalt thus recovered from the nickel fraction contained an activity which was identified as Co^{56} by means of its characteristic 72-day half-life and its 1.5-Mev particulate radiation as identified from aluminum and beryllium absorption experiments. The fact that Co^{56} had grown into the sample definitely proved that Ni^{56} was present in the nickel fraction originally isolated.

The resolution of the total decay curve of the nickel fraction indicated values of 5.6 days and 6.0 days, respectively, for the Ni^{56} half-life in two separate experiments.

Comparison of the counts of Ni^{56} and its Co^{56} daughter on a Geiger counter indicated a counting efficiency of approximately 28 percent for the Ni^{56}. This counting efficiency would indicate that some particulate radiation is associated with the Ni^{56}. The charcter of this particulate radiation could not be determined due to the low level of activity in the sample.

In order to isolate Ni^{56} in larger quantities, elemental iron was bombarded with helium ions. Conditions were such that the $(\alpha, 2n)$ reaction predominated to give Ni^{56} as the principal nickel activity through the reaction $Fe^{54}(\alpha, 2n)Ni^{56}$. The radiation from the nickel fraction was measured through the use of a scintillation detector connected to a pulse analyzer. Four distinct peaks were observed corresponding to gamma-rays of approximately 0.16, 0.5, 0.8, and >1.4 Mev of energy. In addition there was less definite evidence for another peak corresponding to a gamma-ray of approximately 0.25 Mev; this was largely masked by the peak at 0.16 Mev and consequently the characterization was not very exact. The peak corresponding to a gamma-ray of 0.5 Mev includes annihilation radiation from the Co^{56} daughter and possibly from the Ni^{56}. Comparison of the counts due to Co^{56} with those due to Ni^{56}, however, indicates that there is also an independent gamma-ray of about this energy associated with the decay of Ni^{56}. The decay of the sample was followed on the scintillation pulse analyzer over a period of approximately twelve days and activity included in the 160-kev peak decayed with a half-life of six days. The activities of the other three peaks exhibited a half-life of approximately six days at the start and then a gradually increasing half-life as the decay proceeded. Analysis of the radiation on a crude beta-ray spectrometer indicated the presence of both positrons and negatrons, but the positrons could be accounted for in the main by the undecayed Ni^{57} which was present. The negatrons appeared to be mainly conversion electrons.

From this work it may be deduced that (1) the half-life of Ni^{56} is 6.0 ± 0.5 days; (2) there are at least four gamma-rays associated with the disintegration, with energies of approximately 0.16, 0.5, 0.8, and >1.4 Mev; (3) the decay is mainly by electron capture rather than positron emission.

The isotope Ni^{56} should be especially interesting to study due to the fact that its nucleus is composed of 28 neutrons and 28 protons and there are indications that 28 is a "magic number" for both protons and neutrons.[3-5]

I wish to express my appreciation for the guidance and advice of Glenn T. Seaborg. I also wish to thank P. C. Stevenson, D. F. Martin, G. B. Rossi, and the crew of the 60-inch Crocker Laboratory cyclotron, and J. T. Vale and the crew of the 184-inch cyclotron for their cooperation. The work on the nickel fraction from the bombardment of iron with alpha-particles was performed in cooperation with Mr. Per Kofstad.

* This work was performed under the auspices of the AEC.
† This nuclide has also been studied by R. K. Sheline and R. W. Stroughton [see this issue, Phys. Rev. **87**, 1 (1952)].
‡ Major, United States Air Force.
[1] W. J. Worthington, Jr., University of California Radiation Laboratory Report No. 1627 (January, 1952).
[2] R. M. Diamond and J. M. Hollander (private communication, May, 1951).
[3] M. G. Mayer, Phys. Rev. **78**, 16 (1950).
[4] W. Low and C. H. Townes, Phys. Rev. **80**, 608 (1950).
[5] J. Sanada and Y. Yoshizawa, Phys. Rev. **83**, 663 (1951).

Radioactivity Produced in Platinum by Slow Neutron Capture

B. C. HALDAR*
Department of Chemistry,† Notre Dame University, Notre Dame, Indiana
(Received April 28, 1952)

BY slow neutron capture platinum can produce only the radioactive isotope of mass numbers 191, 193, 197, and 199. Previous workers[1-3] have assigned the half-lives 4.33 days, 18 hr, and 31 min to the mass numbers 193, 197, and 199, respectively. McMillan and his co-workers[2] observed by the bombardment of platinum with slow neutrons an activity of half-life 3.4 days which they assigned to the mass number 197. Later Sherr, Bainbridge, and Anderson[4] did not observe the 3.4-day activity but found an activity of long period and of small intensity. Recently Cork and others[5] have reported that by the slow neutron bombardment of supposedly pure platinum in Oak Ridge and Argonne piles they have observed three activities of half-lives 18 hr, 3.4 days, and 82 days. According to them the 3.4-day activity associated with platinum is due to 3.3-day Au^{199} produced from 31-min Pt^{199} and the 82-day activity is possibly due to Pt^{197}. It appears from the work of Cork and others[5] that the active platinum used in their experiments has not been purified from 3.3-day Au^{199} produced by the β^-decay of 31-min Pt^{199}. Since 31-min Pt^{199} is produced by slow neutron reaction with platinum along with other activities, it is expected that their experiments would give results characteristic of Au^{199}. If the 3.3-day activity is due to Au^{199}, it should be absent in the active platinum chemically purified from gold activity. In the present study pure platinum bombarded with slow neutrons in the Oak Ridge pile has been chemically purified