$I=0$ state lies below that for $I=1$, thus providing the 0−0 transition necessary to explain the well-known pair emission of the lowest excited state in O^{16}, and that the order of magnitude of the splitting is compatible with reasonable assumptions about the interactions. In N^{15} one may have an excited s-nucleon coupled to a p-shell resembling C^{14} or N^{14} having $J=0$ or 1 (or more) and giving rise to single levels and doublets.

Such an interpretation has a simplicity appropriate to the simple doublet pattern observed and to other indications of nuclear shell structure, but in detailed consideration of the lower doublet of O^{16} it unfortunately encounters obstacles which, unless otherwise overcome, make it desirable to seek instead a mechanism capable of pairing states of quite different angular momentum, since the doublets seem too numerous to be fortuitous. Wayne Arnold has recently observed[5] a pronounced alpha-gamma-angular correlation in $F^{19}(p,\alpha)O^{16}$ which seems to indicate $I=3$ rather than $I=1$ for the 6.1_4 Mev state of O^{16}, in striking contrast to $I=0$ for the 6.0_6 Mev state. Furthermore, the odd parity of the configuration p^5s, while consistent[6] with the existence of the three known pair resonances, requires that the two known pair-plus-long-range-alpha-resonances be chance superpositions of states of different parity-angular-momentum in the rather crowded spectrum of Ne^{20}.

[1] R. Malm and W. W. Buechner, Phys. Rev. **78**, 337 (1950) as reported at New York (2.71 Mev is C^{13} contamination), and personal communication through the kindness of D. M. Van Patter, who has also observed a doublet in B^{11}, perhaps significantly at 6.8 Mev; Kinsey, Bartholomew, and Walker, Phys. Rev. **77**, 723 (1950); Guggenheimer, Heitler, and Powell, Proc. Roy. Soc. **190**, 196 (1947); L. D. Wyly, Phys. Rev. **76**, 316 (1949).
[2] Chao, Tollestrup, Fowler and Lauritsen, Phys. Rev. **78**, 88 (1950); Streib, Fowler, and Lauritsen, Phys. Rev. **59**, 253 (1941); Becker, Fowler, and Lauritsen, Phys. Rev. **62**, 186 (1942); R. Walker and B. McDaniel, Phys. Rev. **74**, 617 (1948); Freeman and Baxter, Nature **162**, 696 (1948).
[3] M. G. Mayer, Phys. Rev. **78**, 16 (1950); Haxel, Jensen, and Suess, Naturwiss. **36**, 155 (1949).
[4] W. M. Elsasser, J. de phys. et rad. **4**, 549 (1934); W. Heisenberg, Zeits. f. Physik **96**, 473 (1935); E. Feenberg and E. Wigner, Phys. Rev. **51**, 95 (1937).
[5] Private communication at the suggestion of Arthur Roberts.
[6] J. R. Oppenheimer and J. S. Schwinger, Phys. Rev. **56**, 1066 (1939); D. M. Dennison, Phys. Rev. **57**, 454 (1940).

The Half-Life of Cm^{242}

G. C. Hanna, B. G. Harvey, and N. Moss
Atomic Energy Project, National Research Council of Canada, Chalk River, Ontario, Canada
April 10, 1950

DURING recent work on the neutron irradiation of americium it was noticed that the Cm^{242} produced decayed at a rate significantly different from that expected from the published half-life of 150 days.[1] Accordingly an attempt was made to measure this half-life with reasonable precision.

Three sources were available whose disintegration rates were known with adequate accuracy at a sufficiently early date to give a good value for the half-life. These were all unseparated sources containing the whole of the parent americium. This is not a serious drawback as the curium α-rays are more energetic and were well resolved from the α-rays from any isotope of americium present. A small correction has to be made, however, for the growth of Cm^{242} from the long-lived ground state of Am^{242} which is present.[2]

The activity of the sources was measured in a low geometry proportional counter using a 30 channel pulse analyzer. The counter, designed in this laboratory by Mr. A. G. Ward several years ago, can be trusted to maintain a constant geometry over an indefinite period of time. It consists essentially of a vertical cylinder with a removable base on which is placed the source to be counted. The lower half of the cylinder contains a collimator defining the geometry. The space above the collimator hole contains a proportional counter. The whole is filled with methane at a suitable pressure. The pulse size is a measure of how far an α-particle has penetrated the counting volume and consequently the several disintegration rates of the components of a mixed source can be measured simultaneously.

Table I. Disintegration data on Am^{241} and Cm^{242}.

Source	Date	Days	Am^{241} disin./min.	Cm^{242} disin./min.	Ratio Cm/Am	Half-life calculated from time zero
			($\times10^{-5}$)	($\times10^{-5}$)		
	16:2:49	0	1.492±0.017	2.550±0.021	1.709±0.022	—
A	1:11:49	257	1.465±0.014	0.832±0.008	0.568±0.008	161.8±2.7
	16:2:50	365	1.481±0.014	0.537±0.005	0.362±0.005	163.1±2.2
			($\times10^{-6}$)	($\times10^{-7}$)		
B	18:7:49	0	5.5±0.2	6.522±0.020	—	—
	25:11:49	130.2	not measured	3.747±0.010	—	162.9±1.5
			($\times10^{-5}$)	($\times10^{-6}$)		
	3:6:49	0	1.5±0.1	21.58±0.14	—	—
C	20:11:49	180	1.6±0.1	9.987±0.020	—	162.0±1.5
	14:2:50	256	1.6±0.1	7.254±0.020	—	162.7±1.0
	16:3:50	286	not measured	6.364±0.015	—	162.3±0.9

The three sources were all prepared by evaporation from solution on mirror-finish platinum disks and ignited to red-heat. *Source A*, produced by a very short irradiation, gave comparable Am^{241} and Cm^{242} disintegration rates. *Sources B and C* were aliquots of much more heavily irradiated sample of americium.

Source A was rather small, requiring very long counting times for good statistical accuracy, but the americium and curium counting rates could be measured with comparable precision. With sources B and C the very intense curium activity was accompanied by a finite low energy tail which precluded a very accurate estimation of the americium. The total activity of these two sources was measured and the result corrected for the presence of americium and the growth of Pu^{238}. The uncertainty in these corrections was not large enough to produce a significant error. The geometry of the counter was checked by counting a standard Pu^{239} source on each occasion. The results are given in Table I.

We are somewhat apprehensive that the sources would be weakened by aggregate recoil and give a spuriously short half-life. The constancy of the americium counting rate of source A suggests that this effect is small since it is likely that americium would accompany any curium removed in this way. However, a more satisfactory check that this effect was not significant was obtained by monitoring the inside of the containers in which the sources had been kept: no activity was detected with an instrument sensitive to a few hundred α-disintegrations per minute.

It is possible that sources B and C contain some Cm^{243} formed by a second neutron capture during irradiation. However, the α-activity from this isotope is not expected to exceed a few tenths of one percent of the Cm^{242} activity. The agreement between the half-lives from B and C and the lightly irradiated source A suggest an upper limit of about $\frac{1}{2}$ percent.

Seaborg, James, and Morgan[2] have shown that in neutron irradiated americium there occurs about one β-disintegration of the long-lived ground state of Am^{242} for every 1000 α-disintegrations of Cm^{242} in a fresh unseparated sample. In our measurements the correction for this growth of curium amounts to −0.2 day in the half-life.

Our "best value" is 162.7−0.2 days=162.5 days. The limits of error are probably ±2 days.

[1] G. T. Seaborg and I. Perlman, Rev. Mod. Phys. **20**, 639 (1948).
[2] Seaborg, James, and Morgan, "The new element Americium," AECD 2185.

Measurement of Gamma-Ray Energies with One Crystal*

John A. McIntyre and Robert Hofstadter
Palmer Physical Laboratory, Princeton University, Princeton, New Jersey
April 13, 1950

THE use of scintillations in a single crystal to measure gamma-ray energies[1] may have important applications in nuclear physics because of the possibility of examining sources of very weak radioactivity. In view of this attractive possibility we have studied the pulse-height distributions in clear NaI(Tl)