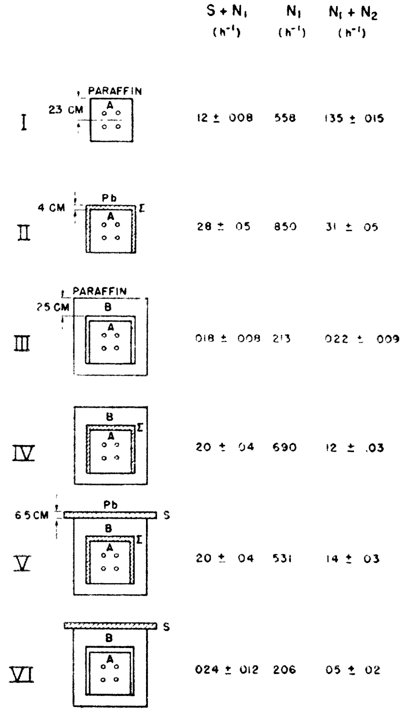

FIG. 1.

Arrangement I: Neutrons associated with extensive showers may be either locally generated in the paraffin A or generated in air, i.e., pre-existing in the showers before entering the detector.

Arrangement II: The large increase in the rate due to the lead Σ (4 cm) reveals production of many neutrons in lead. Two hypotheses may be put forward: (a) Neutrons are generated by the soft component of the extensive showers. (b) Neutrons are generated by the penetrating component of the extensive showers.

Arrangement III: The extra paraffin B (25 cm) prevents the neutrons coming from the air, with energies smaller than $\sim$10 Mev, from reaching the detector. The strong decrease in the rate shows that most of the neutrons recorded with Arrangement I are generated in the atmosphere, and have energies lower than 10 Mev.

Arrangement IV: The production of neutrons in the lead is confirmed.

Arrangement V: The lead S (6.5 cm) does not vary appreciably the rate observed with Arrangement IV. This means that if the neutrons are produced by the soft component (hypothesis (a)), they must be produced mostly in S (a substantial fraction of the soft component arrives in the vertical direction and is absorbed by 6.5 cm Pb), and their energies must be very high in order to cross more than 40 cm of paraffin. If the neutrons, instead, are produced by the penetrating componen (hypothesis (b)), they may be produced in Σ, with not necessarily high energies (<10 Mev).

Arrangement VI: The strong reduction due to the withdrawal of the lead Σ indicates that hypothesis (a) is inconsistent, so that neutrons must be principally produced in lead *by the particles* (mesons or nucleons) *of the penetrating component.*

It is interesting to note that the same behavior is shown by the rates of both the incoherent neutrons N_1 and the coincidences N_1+N_2. We also think that the incoherent neutrons produced in lead are mostly generated by a penetrating component, rather than by $\gamma-n$ reactions or any other processes originated by the soft component.

As for the fraction of neutrons produced in the air, no direct information may be drawn from our experiments, but it is reasonable to assume that most of these neutrons also, both associated and not associated with extensive showers, are genetically correlated to some penetrating component, with a small contribution, if any, from the soft component. Furthermore, the well-known strong altitude dependence of the total neutron component probably rules out light mesons as parent of the neutrons and supports the nucleonic component as the mean responsible for the production of neutrons in the cosmic radiation.

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Shape of the Positron Spectrum of Cu^{61}

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June 3, 1948

In order to investigate further the large deviation from the Fermi theory of beta-decay previously observed[1] in the positron spectrum of Cu^{64}, we have studied the momentum distribution of the positrons of Cu^{61} in the same high resolution 40-cm radius of curvature shaped field magnetic spectrometer.[2]

The measurements were made under the same ideal conditions that prevailed for the Cu^{64} study. The Cu^{61} source was prepared by bombarding a nickel target with 12-Mev deuterons. The active copper was electrochemically separated and uniformly deposited on 0.02-mg/cm^2 Zapon backing. The 0.4-cm wide source had a thickness of less than 0.1 mg/cm^2. The same thin window G-M counter, which transmits electrons down to 2.0 kev, was used. Measurements were limited to the region in which the transmission of the counter window is independent of energy.

The results are shown in the Fermi plot of the data in Fig. 1. All parts of the spectrum were found to decay with the same period of 3.33 hours. The high energy end of the spectrum is in good agreement with the straight line predicted theoretically for an allowed transition. Since the statistical errors are based on more than 25,000 counts per point, the extrapolated end point can be determined quite accurately as $W_0=3.36$ mc^2, which is equivalent to 1.205 ± 0.005 Mev. This is in good agreement with the

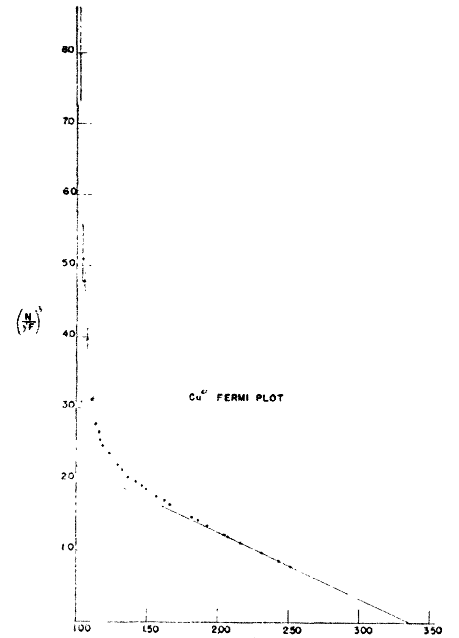

FIG. 1. Fermi plot of the momentum spectrum of Cu^{61} positrons. The extrapolated end point is at $W_0=3.36$ mc², corresponding to 1.205 Mev. The deviation from the theoretical straight line begins at $W=2.0$ mc².

value obtained by Bradt *et al.*,[3] and considerably higher than the value shown in the Segrè chart.[4]

As in the case of Cu^{64}, a large deviation from the Fermi theory is observed at low energies. In this case, the excess of positrons appears for all energies below W = 2.0 mc².

In Fig. 2 we have plotted the ratio of the experimental number of positrons per unit momentum interval to that predicted by the theory as a function of the energy, *W*. The data for Cu^{64} are shown for comparison.

Since Cu^{61} and Cu^{64} have the same nuclear charge, Z, it would appear that the difference in the nature of the deviation for the two isotopes cannot be explained in terms of Coulomb effects on the positrons. It would be of additional interest to compare the spectra of two allowed transitions having the same end points but different Z. Such a comparison is possible between Cu^{61} and N^{13}. It is perhaps significant that the data of Siegbahn and Slätis[5] for N^{13} begin to deviate from the theory at just about the same energy as our data for Cu^{61}. However, since their data were obtained with a source of "some mg/cm²," a more detailed comparison is not justified at low energies.

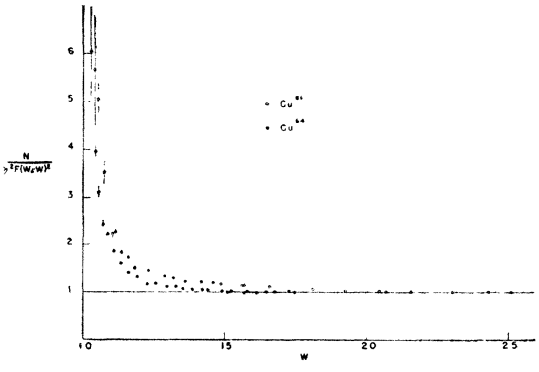

FIG. 2. The ratio of the observed number of positrons per unit momentum interval to that predicted by the Fermi theory for an allowed transition as a function of the total positron energy. The open circles are for Cu^{61}. The closed circles show the data for Cu^{64}.

We wish to express our thanks to Mr. H. Clay Price, Jr. for assistance in obtaining the data.

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Erratum: On the Nuclear Moments of I^{127}, Ga^{69}, Ga^{71}, and P^{31}

[Phys. Rev. **73**, 1112 (1948)]

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IN the above letter, line 13 of column two on page 1112 should read

$$\nu(Ga^{71})/\nu(Na^{23})=1.1529\pm0.0004$$

instead of

$$\nu(Ga^{71})/\nu(Ga^{69})=1.1529\pm0.0004.$$

Errata and Addendum: On the Mechanism of Electron Emission at the Cathode Spot of an Arc

[Phys. Rev. **73**, 1214 (1948)]

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IN a recent Letter to the Editor under the above title, several errors appear, *viz.*: *p* for rho in the first two formulae, alpha for *d* in the first formula, $10^{-4}N$ for $10^{4}N$ in the third formula, Mc for sec in the next to the last paragraph. As normal velocity components are considered, a factor $\frac{1}{3}$ should appear before the integral in the second formula. The error in the third formula, the only one of consequence, invalidates the temperature calculation. It seems better to replace transit time considerations by the following picture of processes taking place at the cathode surface.

In a Hg arc, some 10^{21} ions hit unit area of the cathode spot per unit time. Having energies of about 10 e.v. many of them may penetrate to depths of one or more atomic