tions subtending solid angles of 0.16 steradian at the source (source to counter distance *ca.* 2 inches). The results are shown in Table I. The correlation doubles as expected when the x-rays are

TABLE I. Coefficient ϵ in the correlation function $1+\epsilon\cos^2\theta$.

Nuclide	Coincident radiations	ϵ (this work)	ϵ (others)
Tm^{170}	$\beta-\gamma$	-0.104 ± 0.037	
	$\beta-\gamma$	-0.259 ± 0.053 (1 g/cm² Cu)	
Rb^{86}	$\beta-\gamma$	$+0.035\pm0.020$	
Co^{60}	$\beta-\gamma$	$+0.003\pm0.015$	-0.003 ± 0.01[6]
Sc^{46}	$\beta-\gamma$	$+0.006\pm0.026$	
	$\gamma-\gamma$	$+0.130\pm0.040$	$+0.20\ \pm0.035$[7]

absorbed. This is consistent with the expected isotropic distribution of K x-rays. These particular results are still somewhat uncertain on an absolute basis as no vacuum chamber was used and scattering in air reduces the correlation. A forbidden-shaped beta-spectrum is thus indicated in the gamma-branch. Spectrographic coincidence measurements are in progress to investigate this point and to obtain the angular correlation as a function of the beta-energy.

The correlation in Rb^{86}, $\epsilon=-0.094\pm0.015$, reported by Frankel,[4] was examined. Cs^{134} impurity was removed by an ion exchange column separation. Coincidences were measured at 0° and 90° and no negative correlation found. A possible small positive correlation as given in Table I is in agreement with preliminary unpublished results of other independent workers.[5]

As a check on the apparatus, measurements were made on the $\beta-\gamma$-coincidences from Co^{60} and the $\beta-\gamma$- and $\gamma-\gamma$-coincidences from Sc^{46}. For the $\gamma-\gamma$-measurements a thick crystal replaced the thin beta-crystal. The results shown in Table I are in agreement with other workers.[6,7]

I am grateful to D. W. Engelkemeir for the use of the scintillation coincidence counting equipment, and to R. Garwin for many helpful discussions and the suggestion of the possibility of finding angular correlation in Tm^{170}.

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New Beta-Emitting Isotopes in Region of Tungsten*

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SAMPLES of tungsten, rhenium, and osmium which had received considerable neutron exposures in a nuclear reactor were examined for products of consecutive neutron-capture by the heaviest stable isotope of each element. Thus, W^{188}, Os^{194}, and Re^{189} resulting from successive neutron captures in W^{186}, Os^{192}, and Re^{187}, respectively, were sought. A long-lived activity was found in the rhenium after decay of 50-day Re^{184}. Further work is being done to ascertain whether this is due to impurity, to a nuclide attributable to mass 189, or to the recently described[1] Re^{183} of 240-day half-life. Association with the latter is hardly likely in view of the activation with slow neutrons. Neither W^{188} nor Os^{194} could be observed directly owing to masking by comparatively large amounts of long-lived known isotopes of these elements formed by first-order neutron capture, but the presence of Re^{188} and Ir^{194} daughters in tungsten and osmium, respectively, demonstrate conclusively the presence of the two parent activities. All half-lives appear to be of the order of months, but further work is being done to determine these values accurately, and the data will be reported at a later date.

* This work has been performed under contract with the AEC.
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Erratum: A Cloud-Chamber Study of Cosmic-Ray Nuclear Interactions at 3260 Meters Elevation

[Phys. Rev. **77**, 342 (1950)]

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THE portion of text from line 6, column 1, page 343, commencing with "The median angle . . ." to line 6, column 2, page 343, ending with ". . . showers were recorded" was meant to be printed as a continuation of the abstract.

Are Mesons Elementary Particles?

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IN a recent paper with the above title, Fermi and Yang[1] investigated the possibility of considering the π-meson as a composite particle formed by a nucleon and an antinucleon. This idea is related to one on which we have been working for some time.[2] However our results differ from those of Fermi and Yang. We find that the $^1S_0$ state has to be excluded because its energy tends to zero rather than to 2 Mc^2 as the interaction goes to zero. On the other hand the $^3P_0$ state appears to give an acceptable solution. These results apply to the case of the vector interaction adopted by Fermi and Yang.

If one takes the tensor type of interaction he finds that $^1S_0$ solutions exist for one sign of the interaction parameter and $^3P_0$ solutions for the other. Since it would follow that not only a proton and an antineutron but also a proton and a neutron would form composite particles, it appears that this type of interaction must be discarded.

Details of the calculations will be published shortly.

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Commutator Equations for Fields Derived from a Variation Principle

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IN view of the recent developments of "commutator"[1] or "quantal"[2] equations for fields, it may be of interest to see whether such equations can be developed directly from a variation principle. We shall take as an example the electromagnetic field in vacuum in this report, the work for other types of fields in current use in quantum mechanics being quite similar.

For the electromagnetic field in vacuum, the integrand in the variation principle which leads to the classical equations is

$$L=-\tfrac{1}{4}F^{\mu\nu}F_{\mu\nu}, \tag{1}$$