of the cosmic ray ionisation and the horizontal magnetic intensity. This was done using Charlier's method[3]. Taking all observations of the year 1933 (eleven months, since in April no observations were taken) we obtained the following values:

Case (*a*) (10 cm. lead screen on all sides)	$r = -0{\cdot}12$	(January to December 1933)
Case (*b*) (no lead screen on top of apparatus)	$r = -0{\cdot}28$	

The negative values of r indicate that, on the whole, an anti-parallelism between the two magnitudes does exist, in concordance to W. Messerschmidt's results. The numerical values of r are very low, therefore we must conclude that the relationship is rather slight.

It is remarkable, however, that if we exclude the first three months of 1933, in which several slight alterations of our Steinke apparatus had to be made, we obtain a much better correlation:

Case (*a*) (10 cm. lead on all sides)	$r = -0{\cdot}19$	(May to December 1933)
Case (*b*) (no lead screen on top of apparatus)	$r = -0{\cdot}57$	

The correlation in case (*b*) is very good, thus indicating that the soft components of the cosmic radiation entering the apparatus when it is not screened from above are more influenced by variations of the horizontal intensity, and this is what is to be expected.

We conclude that our observations indicate that the so-called 'variations of the second kind' of the cosmic radiation are partly due to variations in the opposite sense of the horizontal component of the earth's magnetic field.

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[1] V. F. Hess, H. Th. Graziadei and R. Steinmaurer, *Sitz. Ber. Acad. Wiss. Wien*, **143**, 313–338; 1934.
[2] W. Messerschmidt, *Z. Phys.*, **85**, 332; 1933.
[3] C. V. L. Charlier, "Vorlesungen über die Grundlagen der mathematischen Statistik", Verlag Scientia, Lund, 1920, chap. xiv (Class-Method).

Radioactivity of Potassium

FERMI failed to detect induced β-radioactivity with calcium bombarded by neutrons, and this fact has been attributed[1] to the existence of a closed neutron shell in the calcium nucleus. We suggest alternatively that the failure to detect radioactivity may constitute a proof that the source of the natural radioactivity of potassium is the isotope ${}_{19}K^{40}$ of such small abundance that it cannot be detected by means of the mass-spectrograph.

Aston's work indicates that ${}_{20}Ca^{40}$ is by far the most abundant calcium isotope, the ratio of ${}_{20}Ca^{40}$ to ${}_{20}Ca^{44}$ being 70 to 1, the other isotopes of mass number 42 and 43 being present in very small amounts. Thus by far the greater number of neutrons will interact with ${}_{20}Ca^{40}$ and it seems reasonable, therefore, to suggest that any radioactivity induced in isotopes other than ${}_{20}Ca^{40}$ will be too slight to be detectable. In addition, Fermi has definitely detected proton emission following neutron capture with ${}_{12}Mg^{24}$, ${}_{13}Al^{27}$, ${}_{14}Si^{28}$, ${}_{15}P^{31}$, ${}_{16}S^{32}$, ${}_{24}Cr^{52}$ and ${}_{30}Zn^{64}$, and of these seven isotopes five have even atomic number. It therefore appears likely that the following reaction occurs when calcium is bombarded with neutrons:

$${}_{20}Ca^{40} + n \rightarrow {}_{19}K^{40} + p \uparrow .$$

As a result of such an action, only a very small number of radioactive potassium nuclei could be produced, and assuming ${}_{19}K^{40}$ is the source of the natural radioactivity of potassium, the long life of this isotope explains why no disintegrating electrons were observed.

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[1] Wenli Yeh, *C.R.*, **199**, 1209; 1934.

Radioactivity Induced by Neutrons

AMALDI, d'Agostino and Segrè[1] report that, using neutrons from a radon-alpha particle-beryllium source, they have induced an activity in indium of a very short half-life period (13 sec.) and also one of half-life period of about one hour (54 min.).

Our own unpublished observations on indium show the one hour period and a longer period of several hours (estimated at $3\frac{1}{2}$ h.). If indium is irradiated in air these two periods show strong initial intensities of the same order of magnitude, but if it is irradiated in water, the one hour period is so strongly reinforced that it overshadows the long period and may thereby prevent its detection. Thus three periods appear to exist for indium, and the two shorter ones of these are reported[2] to be strongly water-sensitive.

Indium has two known isotopes[3] (mass numbers 113 and 115, the ratio of their abundance being less than one to ten). It has an odd atomic number and since, apart from the isolated case of hydrogen, there is no precedent for such an element having more than two isotopes, we tentatively assume that no further stable indium isotope is involved. Accordingly we conclude that one of the two indium isotopes is activated with more than one period.

The question arises whether the observed periods can be interpreted on the basis of the primary processes which have so far been recognised in the Fermi effect. These recognised processes are: (*a*) capture of the neutron by the nucleus (all cases so far investigated were reported to be water-sensitive); (*b*) ejection of a heavy positively charged particle—a proton or an alpha particle—from the nucleus (all cases so far investigated were reported not to be water-sensitive). Some isotopes of lighter elements are known to be activated with two or three periods, the ejection of a proton or an alpha particle being quite a common process for elements lighter than zinc (atomic number 30). No such processes have so far been observed for elements heavier than zinc.

In the circumstances the Fermi effect of indium (atomic number 49) seems to deserve further investigation, for which adequate instruments of observation are not at present at our disposal.

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[1] Amaldi, d'Agostino, Segrè, *Ricerca Scientifica*, V, **2**, No. 9–10 November 1934.
[2] Amaldi, d'Agostino, Fermi, Pontecorvo, Rasetti, Segrè, *Ricerca Scientifica*, V, 2, No. 11–12, December 1934.
[3] Wehrli, *Helvetica Physica Acta*, **7**, 6, 611; 1934.