Physics. — *Decrease in the intensity of cosmic rays in different directions and the decay of the mesons.* II. By J. CLAY.

(Communicated at the meeting of May 25, 1940.)

In a previous communication [1]), we have given a comparison of the decrease of cosmic rays in different directions by the atmosphere and the decrease by a layer of water in a vertical direction. As we had in the vertical direction no measurements from 0—10 m water, it was impossible to compare the influence of smaller layers with the decrease in the atmosphere for small angles with the vertical.

It was possible to make a comparison of the decrease for layers of lead in the vertical direction and the decrease in the atmosphere for small angles. And only for small angles it will be possible to distinguish between the two possibilities, if either the decay of the mesons or the abnormal absorption of the gaseous state of matter is the reason of the abnormal behaviour of the rays in the atmosphere, as was supposed by FERMI [2]).

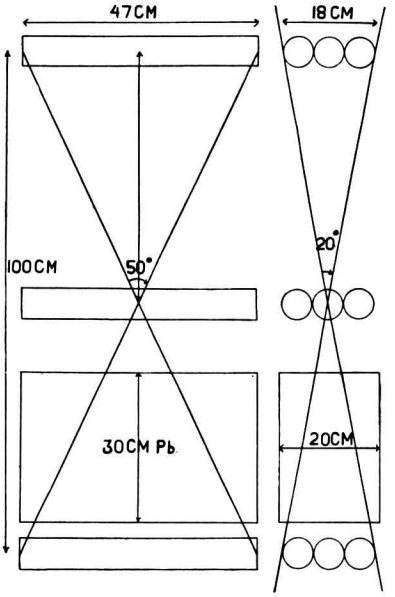

Fig. 1. Countersystem used for measurements in vertical and oblique directions. 30 cm Pb between the counters.

We counted threefold coincidences with counterboxes of 846 cm^2 active surface. The distance between the upper and the lower counter was 100 cm (fig. 1). The boxes with counters and lead were fixed on an iron plate of 2 m length and we could change the inclination of the plate.

Between the lower and the middle counter we had a layer of 30 cm Pb, so that we could be sure that only particles of high penetration power were counted. The number of coincidences in vertical direction was 25.8 per min. The relation of the intensity with inclination can be presented very well by $cos^2 \varphi$ as can be controled by comparing column 3 and 5 and in fig. 2. In column 7 (Table I) the layer of water is given aequivalent to the layer of lead in 6. 1 cm Pb is aequivalent to 6,9 cm H_2O [3]).

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[1]) Proc. Kon. Ned. Akad. v. Wetensch., Amsterdam, **43**, 436 (1940).

[2]) E. FERMI, Phys. Rev. **56**, 1242 (1939).

[3]) J. CLAY and A. v. GEMERT, Proc. Kon. Ned. Akad. v. Wetensch., Amsterdam, **42**, 672 (1939).

1	2	3	4	5	6	7	8
φ	sec φ	$\cos^2 \varphi$	a m water-aeq.	I_φ	b' cm Pb for $I = I_\varphi$	b M water for $I = I_\varphi$	$\frac{b}{a-10}$
0	1.00	1.00	0	1.000	0	0	
10	1.015	0.970	10.15	0.968	6	0.41	2.7
15	1.034	0.932	10.34	0.950	15	1.03	3.05
20	1.060	0.881	10.60	0.875	24	1.67	2.80
30	1.155	0.751	11.55	0.755	53	3.66	2.36
40	1.306	0.586	13.06	0.604	90	6.20	2.02
45	1.414	0.500	14.1	0.504	122	8.41	2.05
45	1.414	0.500	14.1	0.484		8.3	2.0
60	0.500	0.250	20.0	0.221		20	2.0
75	3.89	0.067	38.9	0.072		47	1.7
82	7.20	0.020	72	0.019		110	1.8

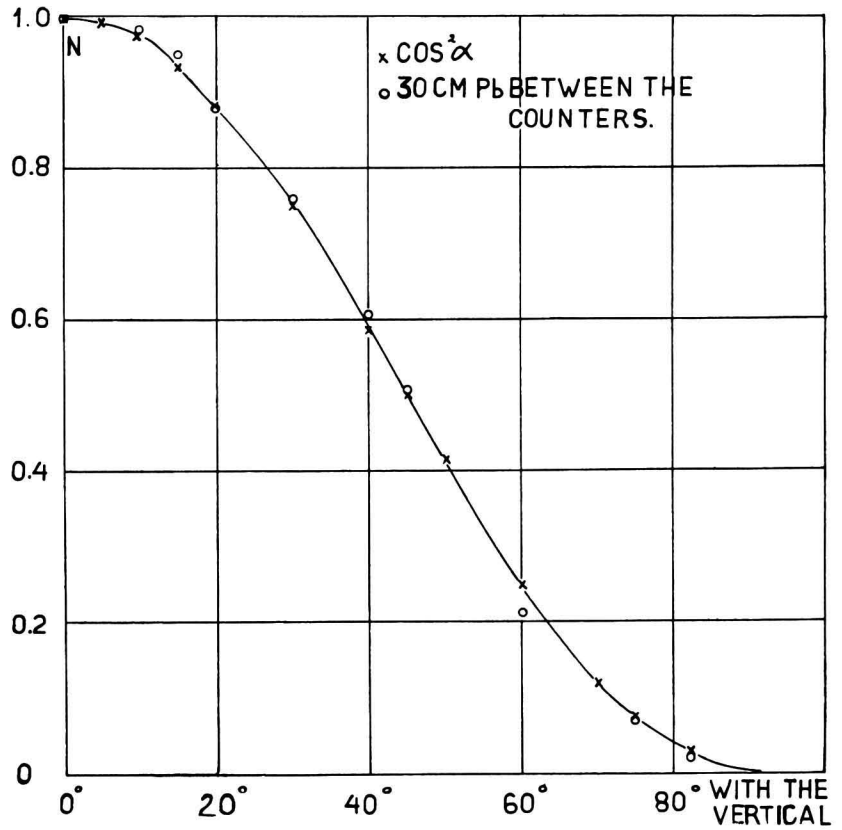

Fig. 2. Variation of the intensity in different directions.

For the series of angles between 45° and 82° only the layer of water could be given, found from the absorption curve in water between 10 and 200 m of depth [1]).

In column 8 the relation is given between the layer of water, transversed in vertical direction and the wateraequivalent of the atmospheric layer, which both give the same decrease of intensity. The relation of these values is also given in fig. 3 for the whole series of inclinations and in fig. 4

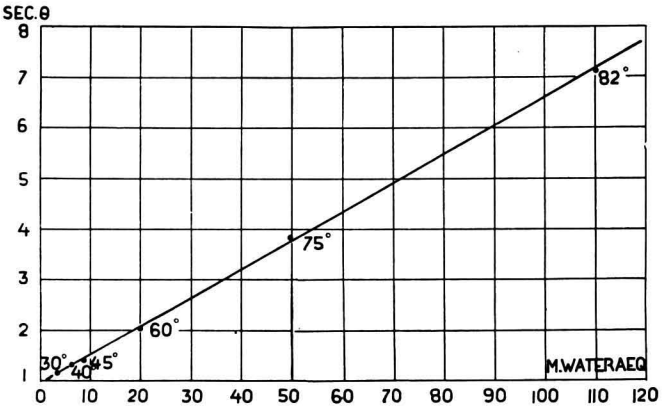

Fig. 3. Relation between sec θ and thickness of waterlayer (b) for aequivalent decrease 20°—82°.

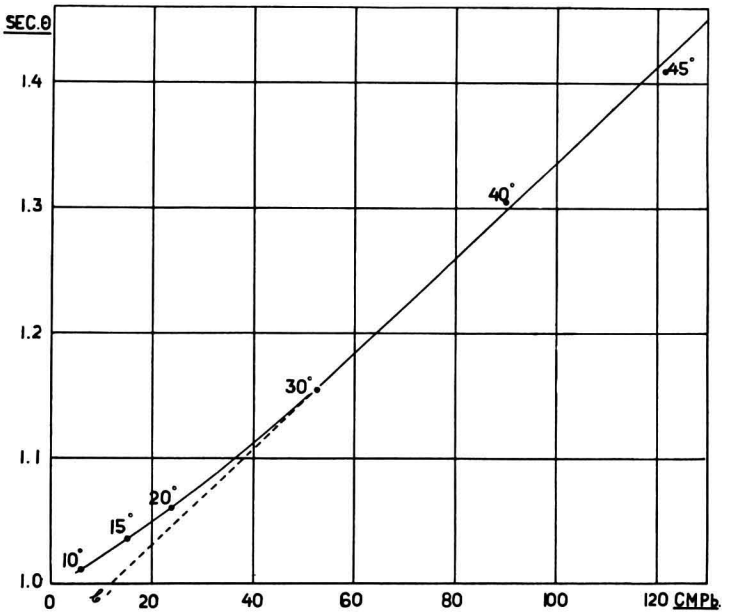

Fig. 4. Relation between sec θ and leadthickness for small angles with the vertical.

for the inclinations to 45° and the accurate values of lead. The decrease in vertical direction can be found in fig. 5.

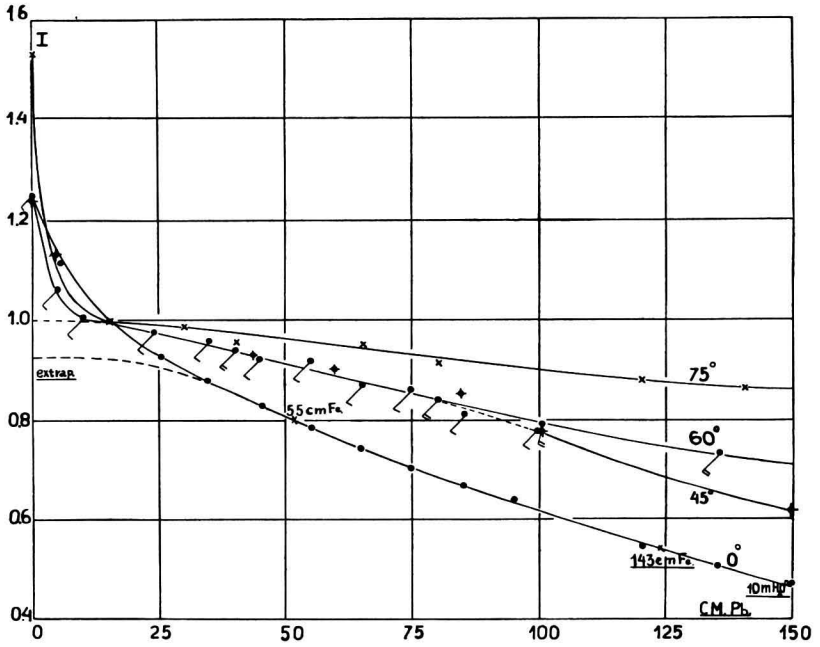

Fig. 5. Decrease of intensity in lead in vertical direction.

If the reason of the abnormal decrease of the atmosphere was the distance of the atoms in the gaseous state, as was supposed by FERMI, there had to be a b (and b′) proportional to sec θ down to $\theta = 0$.

We see from the graph that this is not according to experiment. If the decay of mesons is the origin of the abnormal high decrease in the atmosphere the relation sec θ to b will be linear for higher values of θ as well, but will be changed for the lower values as is expected from the calculations of BRUINS [4]).

We see that the experimental results are in agreement with this second supposition.

The value of the inclination of the line $\frac{d(\sec\theta)}{db'} \times 146 = 0{,}61$, means that the lifetime of the particles is $2{,}6 \times 10^{-6}$ sec. vid BRUINS [4]) graph. 2. As db' is given in cm *Pb* we have to multiply by 146 as 10 m water is aequivalent to 146 cm *Pb*.

[4]) E. M. BRUINS, Proc. Kon. Ned. Akad. v. Wetensch., Amsterdam, **43**, p. 700 (1940).