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ON THE PRODUCTION OF SHOWERS OF PENETRATING PARTICLES

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The purpose of the present experiment was to study the cross-sections for the production of penetrating showers in various materials.

The penetrating showers were detected by a pair of "telescopes" shielded by lead from all sides (of the type used by G.Wataghin(1)). The registered radiation had a minimum range of 18 cm Pb. The telescopes were separated by 16 cm Pb.

Two series of measurements were planned. In the first one we distributed equal number of nucleons (equal masses) of different materials in the same volume, and we obtained the frequencies of showers produced in these materials as the difference of the frequencies of the showers registered with and without the materials. In the second series (which is being performed) equal numbers of nuclei of two different elements are distributed in equal volumes. In this case the frequencies of the showers produced in the materials are proportional to the average cross-sections of the respective nuclei.

In the present note we give the results of the first series, which consisted of experiments A and B. The shower-producing materials were water and iron-filing located above the counter arrangement. In experiment A the upper counters in the telescopes had an area of 400 cm^2 each and the lower ones an area of 250 cm^2. In experiment B all counters had an area of 600 cm^2 each. The resolving time of the circuit was 10^{-6} sec. The results are given in the table

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below.

Table I

	Exp.A	Exp.B
No material	0.412 ± 0.045	1.06 ± 0.08
H_2O (57 $gr.cm^{-2}$)	0.783 ± 0.074	2.07 ± 0.12
Fe (")	0.592 ± 0.049	1.37 ± 0.14
H_2O (120 $gr.cm^{-2}$)		2.02 ± 0.11
Fe (")		1.34 ± 0.12

We see from these data that: a) The registered cross-section per nucleon is larger in the case of water than in the case of iron, indicating that either the absorption coefficient of primaries, or the constitution and multiplicity of the produced showers depends on the nuclear structure. b) With 57 $gr.cm^{-2}$ of water or iron we observed saturation. c) The existence of a difference between the frequencies at saturation in the case of water and iron suggests that the constitution, multiplicity or angular divergence of the produced showers are different in the two cases.

Comparing our results with a recent work of Cocconi and Greisen (2) we obtain the following table(II).

Table II

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TABLE II

	Mass proportional cross-section	Constant cross-section per nucleus	Relative geometrical cross-sections	Same considering also that of the incident nucleon
C (2)	0.99 ± 0.16	~~0.95~~ 1.00 ± 0.16	0.98 ± 0.16	1.02 ± 0.16
H_2O Exp.A	1.13 ± 0.34	0.57 ± 0.17	1.05 ± 0.32	0.92 ± 0.28
H_2O Exp.B	1.19 ± 0.22	0.61 ± 0.12	1.12 ± 0,21	0.98 ± 0.18
[illegible] Exp.A	0.55 ± 0.25	2.60 ± 1.17	0.91 ± 0.41	1.22 ± 0.55
[illegible] Exp.B	0.36 ± 0.20	1.73 ± 0.96	0.61 ± 0.34	0.82 ± 0.45
Pb (2)	0.17 ± 0.10	2.94 ± 1.85	0.44 ± 0.28	0.67 ± 0.42

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In this table we give numbers proportional to the observed increases ~~of~~ frequencies in different materials. The coefficient was chosen so, that the four values should be compatible with unity in each column, if the corresponding hypothesis is correct. We conclude that the ~~XXX~~ appearant cross-sections seem to be proportional to the geometrical cross-sections of the nuclei as indicated in the fourth column.

We thank Prof. G. Wataghin for the suggestion of this problem and for his kind, constant help during the performance of the measurements.

(1) G. Wataghin Phys. Rev. 71, 453, 1947

(2) G. Cocconi and K. Greisen Phys. Rev. 74, 62, 1948