large showers with $N>10^7$ have the standard ratio of the density of μ-meson flux to the density of electron flux.

It is a very noticeable fact that many characters of showers with large number of particles N have small dispersion from shower to shower. It is necessary to notice that the gradual decrease of the fluctuation of character of the atmospheric shower with the increase of the energy of the primary particles, is necessarily expected even in primary protons. But on the other hand, the role of fluctuations should grow with the increase of the exponent γ. The observed figure, perhaps, is the opposite to this expectation: that is, in the energy region where the exponent is increased, the fluctuation decreases. Then we consider that this represents a serious evidence that heavy nuclei are predominant in the high energy region.

Besides, the changes in the distribution of the characters of showers can be attributed to the result of the change of the elementary interaction in the high energy region. For instance, a possible strong excitation of a nucleon with its following decay to some particle at the energy over some critical energy, which cannot be observed in the smaller energy, may give the character a new effect. Consequently we should study more carefully the distribution of many kinds of characters of shower in the dependence of its energy, before we make the decisive conclusions on the change of composition of the primary cosmic radiation with the energy.

It seems to us that the most important thing in connection to this is the information of the Cerenkov radiation at the large distance from the axis, at the same time with the knowledge of the number of particles in a shower (though the Cerenkov radiation at the large distance from the axis is not studied so extensively so far). Besides, it is very important to know the distribution of the age s of showers in the dependence on N at the sea level. "Young" showers with $s\leqq 1$, (at such atmospheric depth where the mean value of s for showers of a given energy is 1.3), show undoubtedly the presence of protons among the primaries.

JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN Vol. 17, SUPPLEMENT A-III, 1962
INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part III

III-2-8. On the Role of Complex Nuclei in the Origin of Development of Extensive Air Showers*

I. L. ROSENTHAL

P. N. Lebedev Institute of Physics, Moscow, U.S.S.R.

If energy spectra of primary heavy nuclei and nucleons are equal, one should expect that the fluxes of complex nuclei and nucleons of a high energy have approximately the same magnitude. In the paper there are considered some qualitative (and sometimes semi-quantitative) consequences of this hypothesis associated with the development of extensive air showers. The hydrodynamic theory of multiple particle production was used for the evaluations. The following conclusions were made:

1. Fluctuations in the development of extensive air showers in the case when the showers produced by nucleons (a) are considerably greater than in the showers produced by heavy particles (b).

2. The value of fluctuations depends essentially on the type of recording devices.

3. One can expect that in the cases (a) the portion of penetrating particles will be less than in the case (b).

4. The showers produced by complex nuclei will be characterized by multi-cores. Average distances between the cores will increase with decrease of the shower power.

* No manuscript has been received and the preprint is reprinted.