Therefore these experiment should be made in all kinds of materials.

Peters, B.: I agree completely. It is also necessary to study the production of spallation products not only as group, but also as individual nuclear species and this will, I believe, be possible only in accelerator laboratories. The reason is that the relative abundance of various fragmentation products will change as a result of radioactive cooling. For instance Boron fragments will be enhanced by the decay of Be^{10}, C^{10} and C^{11} fragments and probably diminished only slightly by the decay of B^{12}. Lithium fragments will be increased by the decay of He^{6} and Be^{7} and decreased by that of Li^{8}, etc. Only a very accurate study such reactions will permit us to decide whether the observed composition is compatible with spallation reaction in a gas consisting of mostly hydrogen with some admixture of helium.

Yagoda, H.: The fragmentation coefficients of heavy nuclei in hydrogen can also be measured directly with the aid of hypersensitive nuclear emulsions which maintain a fair degree of sensitivity at liquid hydrogen temperatures. I believe that a preliminary experiment of this nature has been made at the University of Moscow using the NIKFI emulsions. Perhaps Prof. Zhdanov might like to comment on this work.

Zhdanov, G. B.: We have done one experiment of this kind with improved NIKIFI-R/ emulsions surrounded by liquid hydrogen. The sensitivity of emulsions was about 30 grains per 100 μ. So in principle such an experiment would be possible.

Koshiba, M.: How about He in interstellar medium?

Burbidge: Regarding the hydrogen/helium ratio in interstellar matter, measures of emission lines in ionized region around high temperature stars (*e.g.* Orion Nebula) give a ratio not significantly different from the ratio actually obtained from stars (as might be expected since the high-temperature stars must be young and recently condensed). Probably the interstellar gas should be well-mixed throughout the galaxy, so one should be safe in taking the "cosmic abundance" H/He ratio to apply in the interstellar medium.

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III-1-18. Introductory Remarks

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Since the last Conference in Moscow, in 1959 several important questions regarding the composition of the primary radiation have been clarified. Progress was made particularly in three directions.

1) Evidence has finally been produced to the effect that primary electrons and γ-rays are present near the earth. Adequate technical means for their study appear to be available now. If present day notions about gas density and about the uniformity of nucleon flux in interstellar space are correct, one must expect that, even if there were no specific galactic sources of high energy electrons and γ-rays, there should be a continuous production in interstellar space due to the decay of pions produced in collisions of cosmic ray nuclei with the gas in the spiral arms and the halo. Observations reported at this Conference indicate the presence of these components with approximately the expected intensity.

It is perhaps too early to state that the galactic character of γ-rays observed by

Kraushaar and Clark and of electrons observed by Meyer and Vogt has been established beyond all doubt, but one may expect quite definite information on this point in the near future.

2) There has been considerable progress also in the study of the charge and energy spectrum of the nuclear component.

a) The long persisting discrepance between various measurements of the flux of light nuclei Li, Be and B has been resolved, mainly by better statistics and by carrying out observations so close to the top of the atmosphere that atmospheric corrections become relatively unimportant. At latitude $\lambda=41°$ Dr. Shapiro and his group have made a measurement under only 2.7 g/cm^2 of residual atmosphere; the flux value which they have obtained, seems to be the most reliable so far and is consistent with practically all major recent investigations.

Dr. Shapiro and his group have also succeeded in verifying another important feature of the composition, namely that nitrogen is much less abundant than either carbon or oxygen.

Another result of great interest is that the first satellite measurements of composition reported by Dr. Zhdanov give an indication that the proportion of Li, Be and B in the primary radiation may be strongly energy dependent.

b) New studies on the low energy part of the spectrum have thrown some light on the cut-off mechanism for galactic particles. Of particular interest here are the observations under 1.5 g/cm^2 reported by Dr. Koshiba, the highest balloon flight made so far for cosmic ray studies.

c) Additional flux measurements especially those on the proton and α-particle components at low latitude have filled previously existing gaps in our knowledge of the primary spectrum.

3) The situations in the primary charge spectrum has been clarified sufficiently so that one can now proceed to the next step in analysing the primary nuclear component namely the determination of its isotopic composition.

Studies on the isotopic composition of hydrogen and helium nuclei of galactic origin have begun. The first results have produced some surprises and indicate that such studies will have an important impact on our present concepts of cosmic ray sources, as well as on accelerating mechanisms and the propagation of particles in interstellar space.

In order to present to this Conference in the short time which is available a coherent picture of these main directions of advance, it seemed desirable to combine papers which have been read at the ordinary sessions into general reviews and to refrain from presenting individual research papers in the plenary session. I am very grateful to D. Kraushaar and his colleagues for permitting me to arrange a review which combines into a single report his remarkable results on galactic γ-rays, and the observations on primary electrons made by the Chicago group. Also I would like to express my gratitude to Dr. Koshiba and Dr. Zhdanov for permitting me to arrange the inclusion of their results in a general review of the primary nuclear component.

The first speaker will be Dr. Meyer who will deal with electrons and γ-rays in the primary cosmic radiation. This will be followed by a paper presented by Dr. Waddington on the charge composition and energy spectrum of primary nuclei.

Finally Dr. Kaplon will give an account of progress in the new field of isotopic analysis of light elements in the primary radiation and report some results which have been obtained already.