or to try the synthesis of superheavy elements. In recent years biologists have made predictions that nitrogen or neon ions would be far superior to γ-rays in treating deeply situated malign tumors. Space biology has its own problem: radiation effects of the heavy component of cosmic rays on the nerve tissue of astronauts during long, planetary space trips. The energies involved in the latter two cases are up to 500 MeV/nucleon.

In the present state of the accelerator technology, synchrotron is the only accelerator capable of accelerating ions of any charge-to-mass ratio to energies up to and above 1000 MeV/nucleon. There are, however, a few additional requirements to satisfy. A R. F. accelerating system with a very wide range of frequencies is necessary and the vacuum in the vacuum chamber has to be good enough to avoid excessive losse due to a charge change of ions.

The synchrotron in Princeton, N. J., U. S. A., started to operate as a proton machine in 1963. Its basic parameters are: $B \cdot R = 12.8$ T · m, acceleration time $T = 25$ ms, vacuum $(1 - 2) \cdot 10^{-7}$ torr. In 1969 a program was initiated for the conversion of the synchrotron into a machine capable of accelerating any ion up to uranium, to energies of 1000 MeV/nucleon. The first phase of the project consisted in the acceleration of nitrogen and neon ions. The choice of the ion species was dictated by the need for the most suitable radiation in cancer treatment. In later phases of the project the replacement of the existing epoxy vacuum chamber with a ceramic one is envisaged; this would improve the vacuum down to 10^{-9} torr, necessary for ions heavier than neon.

The mode of acceleration of nitrogen and neon ions is as follows. From a compact Penning ion source a mixture of nitrogen or neon ions in different charge states is extracted, accelerated in a 4 MV Van de Graaff and then the 2+component separated in a B×E mass spectrometer. By passing through a carbon stripping foil of 10 μg/cm^2 thickness the mean charge in the beam is increased to 5—6. The desired species is again separated in an electrostatic analyzer, injected into the main synchrotron ring and accelerated to the final energy.

On July 15, 1971 nitrogen ions were accelerated to 290 MeV/nucleon. This was the first time that heavy ions of cosmic energies have been obtained in the laboratory. In September the energy was increased to 530 MeV/nucleon. The intensity of the external beam was up to $2 \cdot 10^6$ particles per second. At the same time a series of biological experiments was begun.

Note added. On December 15 a neon beam was obtained, with an energy of about 500 MeV/nucleon.

2.11. Study of the phosphorescent component of NaI(Tl) and possibility of its application

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2.12. The K-Shell fluorescence yields of argon, chlorine and sulphur

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The fluorescence yields of noble gases neon, argon, krypton and xenon were measured[1-7] by using the proportional counter. Recently, some modifications of the original method were introduced by which large corrections required previously