This work was supported by grants from the Netherlands Foundation for Pure Research (Z.W.O.).

On Gamma Rays from Intergalactic Space. S. P. SHEN (also at *Physics Department, New York University*) and S. N. MILFORD, *Physics Department, St. John's University*.—Among the possible processes contributing to the gamma-ray background flux above the earth's atmosphere, two are singled out for consideration here: (1) collision of cosmic rays with intergalactic and interstellar matter yielding high-energy gamma rays; (2) decay of intergalactic and interstellar radionuclei (K^{40} ; Tl^{208}) yielding monoenergetic gamma rays below 4 Mev. Considering process (1), the presently available observed upper limit for high-energy gamma-ray flux (5×10^{-3} photon cm^{-2} sec^{-1} sr^{-1}) yields an upper limit of 10 particles cm^{-2} sec^{-1} (order of magnitude) for the omnidirectional flux of intergalactic cosmic rays above 600 Mev, averaged over the visible universe and over the reciprocal of Hubble's constant. Current and future gamma-ray observations, such as from the earth satellite 1961 ν , could lower both upper limits. Thus, if the gamma-ray upper limit becomes 5×10^{-4} photon cm^{-2} sec^{-1} sr^{-1} , the cosmic-ray upper limit would become 1 particle cm^{-2} sec^{-1} , etc. Directional observations could single out the interstellar contribution, which, combined with another method (Milford and Shen, *Phys. Rev.* **122**, 1921, 1961), could in principle yield a rough integral energy spectrum for interstellar cosmic rays. The present method can also be reversed to give some information on the density of intergalactic matter, independently of its ionization state. Furthermore, if intergalactic nuclidic abundances are similar to the solar neighborhood values, process (2) would give a primary gamma-ray flux of order 10^{-7} photon cm^{-2} sec^{-1} sr^{-1} , well below the present detection limit but usable, in principle, as a test for the presence or absence of significant amounts of heavy elements in intergalactic space. Finally, nearby large concentrations of diffuse matter (e.g., Orion complex, Magellanic Clouds, M31) should by these two processes alone give local enhancements of gamma-ray flux distinguishable from the surrounding background.

Photographic History and Suggested Nature of the Radio Source 3C-48. HARLAN J. SMITH and DORRIT HOFFLEIT, *Yale University Observatory*.—In what has been suggested as the first identification of a star with a radio source, Mt. Wilson astronomers noted (Sandage 1960, New York A.A.S. Meeting, December 31, unpublished; but see *Sky and Tel.* **21**, 148, 1961) that the Cambridge object 3C-48 seems to coincide with a peculiar 16th magnitude star. With kind permission of Harvard Ob-

servatory and extensive help from C. Brooks, E. Dirks-wager, S. Gross, B. Marsden, and J. Rodman, we have examined the location of 3C-48 on all plates in the Harvard collection which contain the region.

Of some 2500 plates, most penetrated below 11th magnitude, 600 reached 13th, less than 100 reached 15th, and only 75 showed an image of the 3C-48 object. Between 1895 and 1952, no year had fewer than nine plates, the average being around 40. A full nova or supernova explosion at any time in that interval could scarcely have escaped detection.

Careful magnitude estimates on all the plates showing the image indicate no variation greater than ± 0.2 mag. since 1898.

The plate material is ill-suited for proper motion work, but no conspicuous motion has appeared in first rough measurements.

Despite the negative results reported above, the size and Doppler-broadening of a faint nebulous shell around the star suggest that 3C-48 is nevertheless an exploded object. In fact, a consistent interpretation of the available data can be found with a picture in which 3C-48 is the remnant of a type I supernova similar to the Crab nebula, but intrinsically several times weaker, only $\frac{1}{3}$ the age, and about six times farther away.

Planetary Perturbations and the Perseid Meteor Stream. RICHARD B. SOUTHWORTH, *Harvard College Observatory*.—It is well established that a meteor stream is composed of fragments of a comet; but it is far from being established whether these meteors are shed over a long time or all at once, or whether they are ejected with large relative speeds or small. The icy comet model, and observations of some showers (e.g., the Draconids) suggest that low ejection speeds are the rule. In any event, the meteors are subsequently perturbed by the planets.

If one assumes that the comet ejected meteors slowly and that only gravitational forces affected them thereafter, then the distribution of meteors in the stream at the present time depends only on the comet orbit, the times of ejection, and the planetary perturbations. As the comet itself must have been perturbed, its past orbits are only approximately known, and its present orbit may diverge considerably from the meteors. Nonetheless there exists a probability distribution for the present distribution of meteors in the stream. From this distribution (in the whole stream) one may then deduce the distribution in the sample which strikes the earth.

Double-station photographic observations have reliably determined the distribution of those Perseids which strike the earth. The theoretical distribution has now been computed as above; it is