Photography of the Infrared Coronal Lines 10 747 and 10 798 Å with Image Tubes. JOHN FIROR, *Department of Terrestrial Magnetism, Carnegie Institution of Washington*, AND HAROLD ZIRIN, *High Altitude Observatory, University of Colorado*.—The two infrared lines of FeXIII represent the $^3P_1 \rightarrow ^3P_0$ and $^3P_2 \rightarrow ^3P_1$ transitions in the ground term of p^2 . At sufficiently high coronal electron densities their ratio of intensities should vary somewhat from the normally observed ratio of about 2:1. This effect is similar to that observed in planetary nebulae by Seaton and Osterbrock. As the atomic parameters for FeXIII are not known, it is not certain at what density the deviation should be observed.

Normal photographic methods with hypersensitized I-Z emulsion require at least 30 minutes for proper exposure of the lines with the Climax coronagraph—an impracticable exposure time if a region of the corona is to be explored for variations of line intensity ratio. We have used electrostatically focused, single stage tubes, loaned to us by the Carnegie Image Tube Committee, to speed up exposure. The image on the output phosphor of the tube was photographed on 35-mm film using a fast lens at roughly unity magnification. With a selected tube and a dispersion of about 15 Å/mm, a 28-mm diam solar image and a 50- μ slit width, the exposure time is one minute on Plus-X film. The coronal lines of FeX, XI, XIV, and XV are also obtained by normal methods within a few hours of these exposures.

Quantitative measurements of the spectra are now being made.

Nuclear Cosmochronology. WILLIAM A. FOWLER AND F. HOYLE, *California Institute of Technology*.—In the studies described in this paper we make quantitative use of the radioactive decays of uranium and thorium in cosmochronology in much the same manner as these decays have been employed in geochronology. The paper is divided into two quite different parts representing different views as to the immediate source of the material that now constitutes the solar system.

Model 1. The Autonomous Galaxy. From its origin, the Galaxy has been an autonomous system—no further important additions of material from intergalactic space have taken place at subsequent times. Star formation, stellar evolution, and nucleosynthesis have declined at a steady exponential rate over the whole lifetime of the Galaxy. The duration of nucleosynthesis is found to be independent of this rate over rather wide limits.

Model 2. Steady-State Cosmology and Galactic-Intergalactic Exchange of Matter. The abundance of the elements in intergalactic matter has reached a steady state through interchange with galaxies in

which stars produce elements beyond hydrogen. As a consequence of this same point of view, the Galaxy acquired significant quantities of intergalactic material at various times. This occurred particularly about one billion years before the sun and solar system were formed. Except at epochs of addition of new gas, stellar activity has declined exponentially, as in Model 1.

Consideration of the decay of the radioactive isotopes Th^{232} , U^{235} , U^{238} , according to Model 1, leads to the conclusion that the age of the Galaxy is $15_{-3}^{+5} \times 10^9$ years. Similar considerations according to Model 2 lead to the conclusion that the reciprocal of the Hubble constant is $11 \pm 6 \times 10^9$ years. The error can be reduced to $\pm 2 \times 10^9$ years if the present thorium-uranium ratio is chosen to give a Pb^{208}/Pb^{206} age for the solar system concordant with that given by Pb^{207}/Pb^{206} , namely 4.5×10^9 years.

Observing Close Binaries using Image Intensifiers and High-Speed Photography. LAURENCE W. FREDRICK, *Lowell Observatory, Flagstaff, Arizona*.—A two-stage cascaded image intensifying tube and motion picture cameras have been used to observe close binaries of 0".3 separation and larger. At this separation the mean errors appear to be $\pm 0".05$ in the separation and $\pm 3^\circ$ in position angle. These improve as the separation increases. The internal errors and distortion pattern are discussed, and means of improving these are presented. A regular observing program is being initiated. This has been supported in part by a grant made by the NSF to Carnegie Institute of Washington entitled, Development of Image Tubes for Telescopes.

On Energy Production in Colliding Galaxies. HOWARD D. GREYBER, *General Electric Research Laboratory, Schenectady, New York*. (Now at Geophysics Corporation of America, Boston, Massachusetts.)—A number of very strong radio sources in the sky have been identified visually as two galaxies in collision. One of these, Cygnus A, emits radio energy at the enormous rate of 10^{44} ergs/sec. A factor not mentioned in previous discussions on energy production in colliding galaxies is the surprising observation that very large energy production rates may be obtained from deuterium thermonuclear reactions in the extremely rare hot gas that is formed by the collision. It is shown that for one deuteron in 20 nuclei in the gas of the galaxies, the thermonuclear energy output of Cygnus A would be roughly equal to the radio noise output observed. The possibility of detecting $d+d$ reactions in a strong radio source by looking for the high-energy gamma rays from an earth satellite will be discussed.