image tube depends upon this number and not upon the number of grains per electron, and that therefore an image tube, even with G5 emulsion at 30 kV, operates at a loss.

The storage capacity of a picture emulsion depends upon the number of picture units that can be stored per unit area before serious saturation sets in. We have made measurements of the storage capacity of Ilford nuclear track emulsions when used in the Lick-Stromlo image tube. We find that because of the small grain size of these emulsions, and because of the high densities that can be used without serious saturation effects, these emulsions have storage capacities of from five to ten times that of Eastman Ila-O emulsion exposed to light. An image tube used with nuclear track emulsions should therefore be very good for direct "photography," and should make possible the recording of stars and surfaces fainter than heretofore.

Large-Scale Patterns of the Solar Magnetic Field. V. BUMBA, *Astronomical Institute of the Czechoslovak Academy of Sciences*, ROBERT HOWARD, *Mount Wilson and Palomar Observatories*, AND SARA F. SMITH, *Lockheed Solar Observatory*.—Reduction of $4\frac{1}{2}$ years of daily magnetograms obtained with the magnetograph built by Dr. H. W. Babcock is in progress. The angular resolution from these observations is 23 sec of arc. Isogauss drawings were made from the magnetograms, and synoptic charts were drawn for each solar rotation. It is apparent that the large-scale pattern of the solar magnetic field is for the most part the result of the spreading out and stretching by differential rotation of portions of the magnetic fields of old active regions. These large-scale features persist for many months, while the small-scale patterns which are connected with active regions can change in a matter of days. The main direction of motion of the migrating fields is eastward and poleward. The following polarity in each hemisphere usually predominates in the poleward drift of fields. The polar magnetic field measurements record this quantized migration of fields (Undoubtedly, as has already been pointed out, this drift of following polarities was responsible for the reversal in polarity observed in the polar fields during the last maximum.) It appears that if there is a fixed component of a general solar field it is not apparent in these observations and would have to be less than a few tenths of a gauss. Judging from the distribution of the large-scale magnetic fields, one would observe the sun at a distance during some parts of the 22-yr cycle as a magnetic variable star (if it were possible to observe variations of a few Gauss) with irregular fluctuations and reversals in intervals of the order of a few days.

A portion of this work was made possible by the Advanced Research Projects Agency by means of a contract with the Lockheed Solar Observatory.

Velocity Field of M82 and its Bearing on Explosive Phenomena in that Galaxy. E. MARGARET BURBIDGE, G. R. BURBIDGE, AND VERA C. RUBIN, *University of California, San Diego*.—A detailed spectroscopic study of the central part of M82 has been carried out from spectra taken in nine different position angles. In most position angles, the velocity curves from the emission lines show steep gradients and large dips, when compared with the observed absorption-line rotation curve obtained by Mayall (*Ann. d'Astrophys.* **23**, 344, 1960). These departures from circular motion are interpreted in terms of an expansion stemming from an explosion as discovered by Lynds and Sandage (*Astrophys. J.* **137**, 1005, 1963). The gas which was blown out forms a double cone with half-angle $\approx 20^\circ$. The true space velocity is about 450 km/sec for gas farthest from the center whose line-of-sight velocity can be measured. The velocity curves in position angles close to the minor axis show that the gas in the exploded cones above and below the main body of the galaxy obey approximately linear velocity-distance relations; velocities of the gas in the main body of the galaxy indicate that damping and deceleration has taken place. It is estimated that the explosion took place between 2 and 3 million years ago.

Study of the spectral features due to the stars in M82 suggests that there is a real difference in stellar population between the central part and the outer parts.

From a rediscussion of the energetics of the outburst it is concluded that a total energy of $\sim 10^{57}$ ergs or greater may have been released in the last few million years. It is assumed that the optical synchrotron radiation is produced by electrons with radiation half-lives that are short compared with the age of the primary explosion, so many generations of electrons have been produced. A similar situation is thought to apply to the Crab Nebula and the jet in M87, both of which are also sources of optical synchrotron radiation.

Collision between Ions from the Sun and Neutral Atmospheric Particles. FELIX CERNUSCHI AND SAYD CODINA, *Universidad de la Republica, Montevideo, Uruguay*.—The corpuscular emission of the sun bombards the earth with ions of different masses. Near the earth the magnetosphere changes the original trajectories of electrons and low-energy ions, originating the known effects in the visible range of the spectrum and the very low frequency