perhaps various intermediate compositions. This is consistent with the resolving of red giants at $M = -3$ in M 32; in fact, a rough comparison of the resolved population with the total surface brightness in M 32 seems to confirm its minority role.

The old population I model also provides an acceptable evolutionary explanation for the red excess of remote galaxies. Light from M 32 can be compared, for example, with light which set out on its journey a half billion years ago from the cluster of galaxies in Corona Borealis. The difference between them suggests that giants contribute about 7 per cent less of the total light in ellipticals today than they did a half billion years ago, and that the mean spectral type of the giant representation has shifted from late K to middle K during the same interval.

*Mount Wilson and Palomar Observatories,
Pasadena, California.*

Baum, W. A. and Hall, John S. Present status of the joint image-converter project.

In February 1954 the Carnegie Institution of Washington initiated an exploratory program for the development of photoelectric image tubes to increase the ranges of telescopes. A committee set up by President Vannevar Bush for this purpose includes M. A. Tuve of the Department of Terrestrial Magnetism, chairman, W. A. Baum of the Mount Wilson and Palomar Observatories, John S. Hall of the U. S. Naval Observatory, and L. L. Marton of the National Bureau of Standards. The fundamentals of the problem were outlined earlier by Baum (1954).

Initial experiments under this project (Hall, 1954) were carried out by E. S. Dayhoff at the Bureau of Standards during 1954; they pertained mainly to the properties of image orthicons and vidicons.

More recently, the authors have been working on a line of attack involving commercially-made image converters of a special design. These tubes have a very thin film stretched across the end where the phosphorescent screen would otherwise be located. The photoelectron beam can pass right through this film but gas molecules cannot; consequently, the thin film permits the electronic image to be formed outside the tube while the high quality vacuum inside the tube is preserved. When a photographic plate is placed behind the thin film, the impinging electrons create a latent image just as in Lallemant's system (1951). Laboratory experiments of a similar nature have

also been carried out by Hiltner and collaborators.

The Farnsworth Electronics Company and Radio Corporation of America are both cooperating with us in the experimental production and testing of these new tubes. The present model is about 5 inches long and it comes complete with photocathode, electron optics, and thin film. Since the thin film would be ruptured by atmospheric pressure, the tube is supplied during manufacture with an evacuated glass cap covering the rear end. A stock of spare tubes can thus be kept on the shelf until needed.

When a tube is put into operation, it is installed in a vacuum plate changer. This device provides a rough vacuum around the rear end of the tube so that the protective glass cap can be safely removed from behind the thin film; it also provides a means for getting photographic plates in and out of the system without breaking the vacuum. We hope that this technique will eventually enable astronomers to obtain plates with image tubes in a fashion as routine as that already achieved in electron microscopy.

The primary remaining problem concerns finding the best procedure for producing thin films having optimum characteristics. Many experimental films have been made by Dayhoff at the Bureau of Standards, and similar exploration is now being carried out at the Naval Observatory. The present specifications require that the thin film be self-supporting across a circular aperture 18 mm in diameter, that it withstand a differential pressure of 10^{-5} atmosphere, that gas leakage through it be negligible, that attenuation of the electrons be less than 10 kv, that the loss of resolution due to electron scattering in the film be minimized, and that the film be undamaged by the baking processes required in commercial tube production.

As a second line of attack, an attempt is being made to develop a special type of thin-film converter capable of withstanding full atmospheric pressure, thereby avoiding the complications of the vacuum plate changer described above. In this case the aperture covered by the thin film can be only a narrow slot, but such a slot would be sufficient for many spectroscopic applications. A film of dural 700 A thick was found to withstand atmospheric pressure when mounted across a slot 0.1 mm wide by 12 mm long. Although the scattering of 15 kv electrons by this film was two or three times the desirable maximum, these preliminary results have convinced us that there is