photography in 1942 and the values from the pulsar observations made this year, but it seems most likely that the difference is a technical artefact rather than an authentic secular change in the brightness of the star.

It is also good to learn that astronomers at the Cambridge University Observatories, not to be confused with the Cambridge Radio Astronomy Observatory at which pulsars were discovered, have been in the chase for some time. Dr R. V. Willstrop on page 1023 of this issue describes how photoelectric equipment was built at the observatories as soon as the now discounted hypothesis that pulsars might be white dwarfs was put forward, and how a great deal of telescope and computer time was spent backing that loser. White dwarfs show no variation in intensity. Willstrop also reports that light from the Crab Nebula was observed on November 24, 1968, but that for one reason or another the data were not analysed until after the discovery of light flashes from *NP* 0532. Since then, of course, the Crab Nebula has been re-examined—the flashes are reddish and contain an excess of ultraviolet light—and Willstrop joins the growing list of confirmers of Cocke, Disney and Taylor's discovery.

ELECTRONICS

The Importance of Thin Films

RESEARCH to produce cheap and rugged integrated circuits and a series of projects to determine the electrical properties of thin and even thinner films were among the items with which the Electrical Research Association at Leatherhead sought to impress its guests from the Physical Society on March 5. That micro-electronics is here to stay is, of course, beyond question, but the ERA seems to have appreciated—at least in principle—the part which it can play in bridging the gap between university research and industrial applications.

Afternoon visits may not be the occasions to dig out the inner secrets of a laboratory, but they serve to inject that dose of introspection which helps to keep any research group on its toes. There seems little doubt that thin film technology has a vast growth potential, and the ERA has recently set up a Technology Planning Unit to tackle the problems of technological forecasting.

One of the rewards of what is called thick film research has been the construction of cheap mini-circuits, containing up to forty circuit elements on a 2 cm square. The ERA is at present investigating new and cheaper substances that could be used to replace the costly platinum based materials used for resistors and the copper, silver and gold used for leads. These circuits, costing about two shillings each, have already found a niche in the British Ford motor car.

Tests are also being carried out to investigate long term features such as resistance drift, reliability and lifetimes of circuit elements at different loads and temperatures. The properties of ultrathin films are also being studied, including the mechanism of electrical conduction (*Nature*, **221**, 617; 1969).

Work is in progress on refining the production of thin dielectric films by the technique of sputtering—that is, by removing atoms from a target material by ion bombardment and depositing them onto a substrate to form a thin film. Such films have uses as capacitor dielectrics, protective layers for integrated circuits and barriers against diffusion.

The effect of charge on the way thin films are formed is under study, as are the electrical properties of a range of new substances including ceramics and organic materials. Discontinuous gold films have been found to show high electrical sensitivity to straining, and a new thin film strain gauge is being developed, consisting of an evaporated film of gold on a glass-coated metal plate. This device was on show this week at the Physics Exhibition at Alexandra Palace, but work is still going on to try to overcome the snags of resistance drift and a large temperature coefficient of resistance.

ASTRONOMY

Disagreement about Galactic Age

THE prolonged uncertainty about the age of the Galaxy has evidently not been settled, even if there is a tendency to accept the view, chiefly that of W. H. Fowler and F. Hoyle, that the best estimate is about 15,000 million years. R. H. Dicke has been known to dissent for some time, and the most recent statement of his position has now appeared in print (*Astrophys. J.*, **155**, 123; 1969). On the basis of data about the radioactive decay of uranium, Dicke estimates that the age of the Galaxy is 7,600 million years, with upper and lower limits at 8,500 and 7,300 million years respectively. Although some of the data with which he has worked are more accurate than those available to Fowler and Hoyle in the early sixties, the chief reason why his result does not agree with theirs is his disagreement about the mechanism by which uranium and related heavy elements would first have appeared in the Galaxy.

The use of the uranium isotopes as a means of dating the formation of the Galaxy necessarily rests on calculations of the relative abundances in which the heavy element isotopes were originally produced. There seems now to be no doubt of the correctness of the scheme in which Hoyle, Fowler and their associates have accounted for the formation of successively heavier elements in the course of the evolution of stars from objects made almost exclusively of hydrogen to the point at which they must use helium, carbon and even silicon as nuclear fuels. The end point in this process is a supernova explosion, by means of which matter containing large proportions of heavy elements is scattered into space. The long estimates of the age of the Galaxy depend on the assumption, by Fowler and Hoyle, that isotopes of elements in the radioactive series now present in the Galaxy must themselves have been formed in supernova explosions, which means that the backward extrapolations from current measurements of the proportions of the various radioactive isotopes must lead not to the origin of the Galaxy as such, but to the time between 3,000 and 7,000 million years later at which the Galaxy would have acquired its initial stock of heavy elements.

The essence of Dicke's case is that there was no significant delay between the beginning of the Galaxy and the production of uranium, thorium and the like by the *r*-process nuclear transformations. It is a little