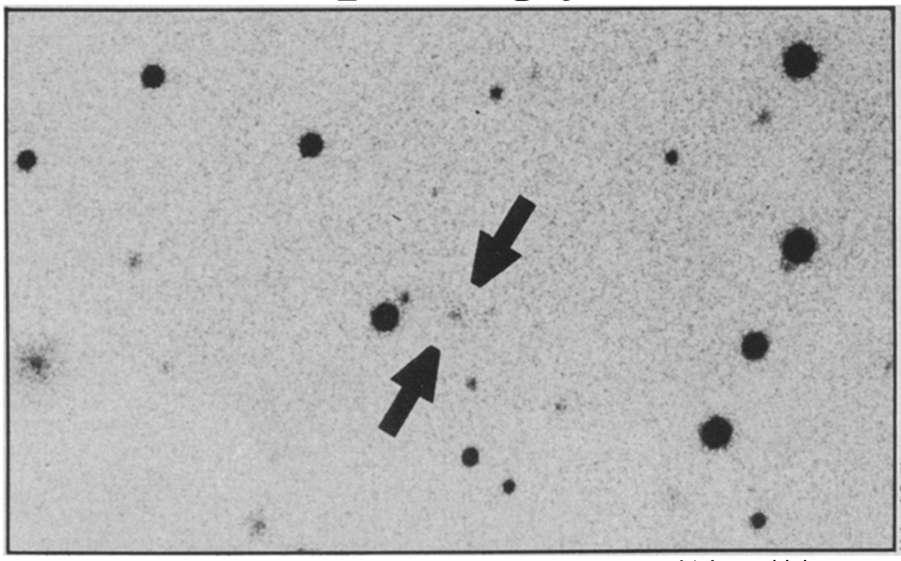
Most Distant Galaxies: Surprisingly Mature

If the universe is in fact 18 billion years old — and that is the figure most often quoted these days — galaxies that are 10 billion light-years away are more than halfway back to the point of origin of the cosmos. Four such galaxies have been found by Hyron Spinrad and John Stauffer of the University of California at Berkeley and Harvey Butcher of Kitt Peak National Observatory. Two are described in a paper published in the March 1 ASTROPHYSICAL JOURNAL. Two more have been found since the paper was drawn up.

The two in the paper are optical galaxies associated with radio sources, and they are designated by their numbers in the Third Cambridge Catalog of radio sources, 3C 13 and 3C 427.1. The observations were done mainly with the Lick Observatory's largest telescope and the detecting instrument known as the Wampler scanner (after its developer, Joseph Wampler of Lick), which is able to build up spectral information from the light of these very faint objects. From the spectral information redshifts for the light of these objects could be calculated as 1.050 for 3C 13 and 1.175 for 3C 427.1. These are announced as the highest redshifts ever found for galaxies.

There are quasars with higher redshifts, up to and above 3, so these galaxies may not be the most distant astronomical objects known, but they are more reliable than quasars for the study of primordial astrophysics and cosmology. Redshift is a stretching of waves so that light is shifted toward longer wavelengths (redder color) than those at which it is normally emitted. Redshift may be due to relative motion between the light source and the observer. It may be due to a strong gravitational field in the source. Or it may be from some exotic cause, nobody knows quite what.

Galaxies near us have been so thoroughly studied that astronomers are confident that they have no gravitational fields capable of producing significant redshifts and none of the redshift exotica proposed for quasars. Galaxy redshifts can be referred completely to recession velocity (the expansion of the universe) and the distances of the galaxies can be calculated by using the Hubble constant. A Hubble constant value of 50 (which seems to be most widely used these days, though it is not uncontroverted) gives 10 billion light-years for these galaxies. The Hubble relation may not apply so simply to quasars. More important, the physical processes in quasars are not so well known nor so well agreed on that they can easily be used to make comparisons between the astrophysics of now and the astrophysics of the distant past.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A galaxy 10 billion years away appears as a faint smudge even at high sensitivity.

Assuming the figure of 10 billion light-years is correct, these two — and now four — galaxies are being seen as they were 10 billion years ago, at a time when they could not have been more than 8 billion years old and were probably 6 billion, maybe younger. Similar elliptical galaxies observed near us are being seen as they were at about age 16 billion years. Comparison of the two groups yields the surprise that the far distant galaxies look more modern and mature than they were expected to. Their light appears not much bluer than that of the nearer galaxies. This indicates that star formation began and ran its course in the distant galaxies quite early, earlier than many theorists would have expected. If star formation was early, formation of the galaxy itself, which necessarily preceded star formation, had to be early too. This evidence indicates that both processes took place within two billion years of the moment of origin. □

Interferon medley: Yeast, genes, hybrids

One act has grabbed the center ring in the frenzied circus of genetic engineering now playing campus and industry laboratories around the world. The star is interferon — the natural protein thought to boost the human immune system and expected to aid in the fight against viruses and cancers. Shortage of interferon from traditional sources created a demand for its production by biotechnology, and last year the gene for a human interferon was transplanted into bacteria (SN: 1/26/80, p. 52). Now scientists announce the successful splicing of an interferon gene into yeast — the first time that yeast has been engineered to produce a human protein.

Although the genetically engineered yeast and bacteria now make similar amounts of interferon — 200,000 molecules per cell — in the long run, yeast are expected to have advantages, David Goeddel of Genentech, Inc. explained in San Francisco at the First Annual Congress for Recombinant DNA Research. Genentech scientists and Gustav Ammerer and Ben Hall of the University of Washington obtained the high yield from yeast in very preliminary work, whereas the bacterial yield was reached only after a year of intensive development. In addition, techniques for growing yeast for commercial use already have been worked out in bread, beer and wine production. While the scientists expect to do even better using yeast, the current bacterial yield, which translates to 100 million to 200 million units of interferon per liter of culture, is as high as that provided by white blood cells in more traditional interferon preparation.

The interferon gene was transferred into yeast by joining it to a segment of yeast DNA that normally turns on the gene for a yeast enzyme. That composite then was inserted into a plasmid of both yeast and bacterial DNA, and the interferon produced demonstrated the expected pattern of antiviral activity.

While transfer of the interferon gene into yeast has obvious commercial applications, that achievement must share the spotlight with other exciting research results. One striking finding is the size of the interferon gene families. Scientists have characterized three types of human interferon, but the one produced by white