CCD group reaches for stars

By DON LEIGHTON

A year ago, a small integrated circuit (IC) engineering and manufacturing group in Building 48 was looking for new horizons, so they literally reached for the stars.

In other words, part of their operation was being phased out and the other people in the group decided they better get a hustle on and "add some value" so they wouldn't suffer the same fate. They had been doing some work on charge coupled signal processing and imaging devices (CCD's), so they focused their efforts toward perfecting the manufacturing process. Building CCD's was also a way to make use of existing IC process equipment.

As a result of this group's success, CCD's will be appearing in some Tek instruments, but they are also being offered to outside customers along with bipolar IC's. (See article on page one.) This outside marketing is a move by Tek's Integrated Circuits Operation (ICO) to further capitalize on Tek's investment.

Charge coupled devices have been around about 15 years, so they aren't new. And there's no secret how they work (if you understand that sort of thing). What the Tek group did, according to Brian Corrie, the group's manager, was develop the manufacturing process to where they can build CCD's bigger and better than anyone else.

Brian and Morley Blouke designed the basic process. But they are quick to point out that it was the operators and technicians who refined the process to where they are producing yields much greater than industry averages. "Some of them volunteered to come in on weekends to work out the bugs and speed things along," Brian recalled. "It was really very much a group effort."

The market for the biggest CCD's probably won't be very large, in part because of the cost (undisclosed), but they are able to produce even the biggies at yields much higher than industry averages.

Now for some explanation of a CCD. Think of it as an electronic sensing device that, coupled with digital electronics and a computer, eventually yields an exceptionally sharp image. In a 1982 article in *Scientific American,* Morley Blouke (then with Texas Instruments) and Jerome Kristian (with Mt. Wilson and Las Campanas observatories) described a CCD as operating somewhat like a field covered with conveyor belts and buckets. After a rain, the conveyor belts would move the buckets to the edge of the field where the amount of water in each would be recorded, thus providing an accurate picture of the rainfall distribution over the entire field.

In a CCD, the buckets become pixels that store electrons when the device is exposed to light. After the exposure, the electrons are progressively shifted (via the charge coupling process) to the edge of the device, recorded digitally, and processed through a computer to produce a digital picture that can be photographed.

But, you might ask, if you are going to photograph the picture, why not use film to start with?

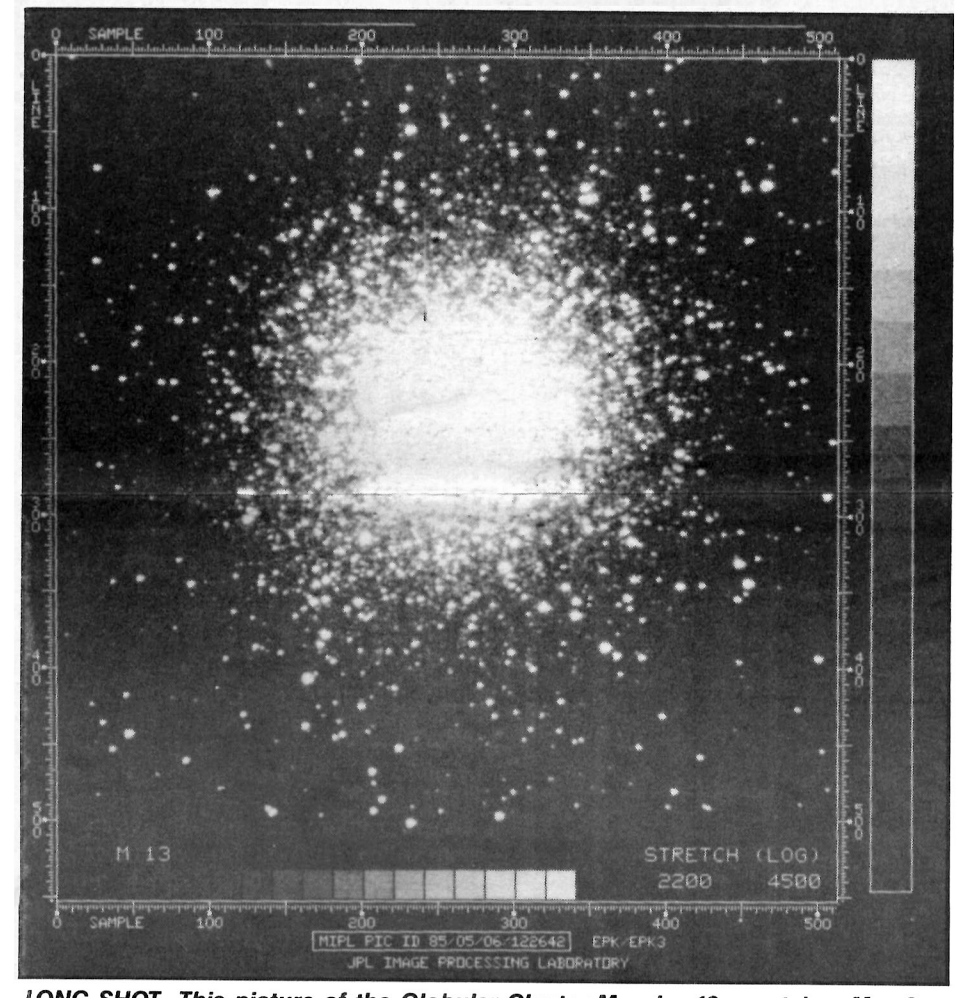
Morley points out that, because of size, CCD's won't replace film, but in some applications they have definite advantages. On a sensitivity scale from 1 to 100, for example, a CCD rates about 70 per cent efficient compared to about 20 per cent for photo-electric cells, and about one per cent for film and the human eye. Additionally, the CCD is sensitive to wavelengths that the other detectors can't "see." That means that with a CCD, astronomers can detect stars that would not be visible with other devices.

Now, more explanation of the bit about reaching for the stars. Besides being an IC design engineer with a special interest in CCD's, Morley is also an avid amateur astronomer and has worked with professional astronomers at several locations, including the Palomar Observatory in Southern California. It was, in part, the interest of these astronomers in bigger and better CCD's that inspired the Tek group to their success.

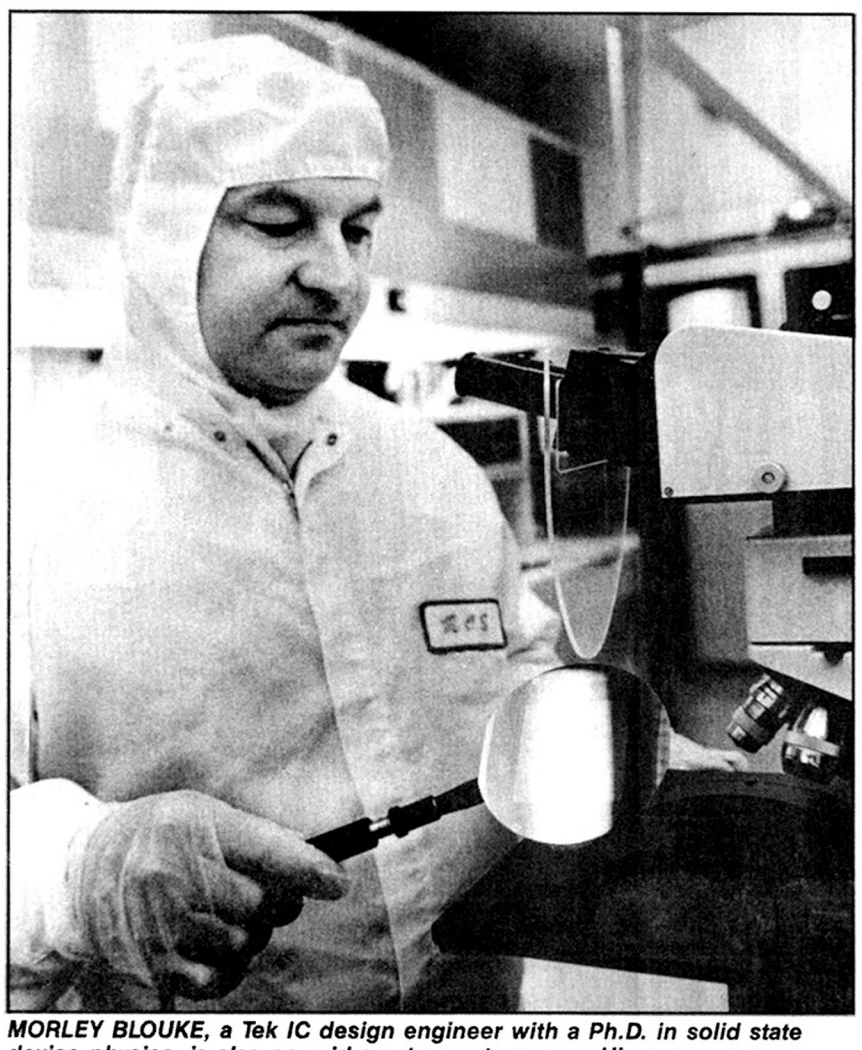
In addition to achieving outstanding results for standard production models of CCD's, this area of Integrated Circuit Operations (ICO) has produced the world's largest CCD. Even their production model, which will be used by most customers, is larger than that of competitors. While the use of CCD's for astronomy is fascinating, most will be used for such things as instrument signal processors and in medical imaging.

There's not a whole lot of similarity between building CCD's and making pancakes, but that comparison will serve to illustrate the odds against building the world's largest CCD. Suppose you're cooking pancakes in a frying pan. Now if you make small pancakes, and don't crowd them, and use the right size spatula to turn them, you can get a pretty high yield of perfect pancakes. But suppose you decide to build one giant pan-sized pancake. The odds of getting it turned over successfully are pretty low unless you devise special equipment and/or techniques.

At the time they started on their big CCD, Brian says, their odds for success were probably about one per cent. Although they have successfully produced the large size, they don't have one mounted and wired up yet for actual application. But you can bet they are anxious to see the results when they try one in connection with the 200-inch telescope at Palomar.

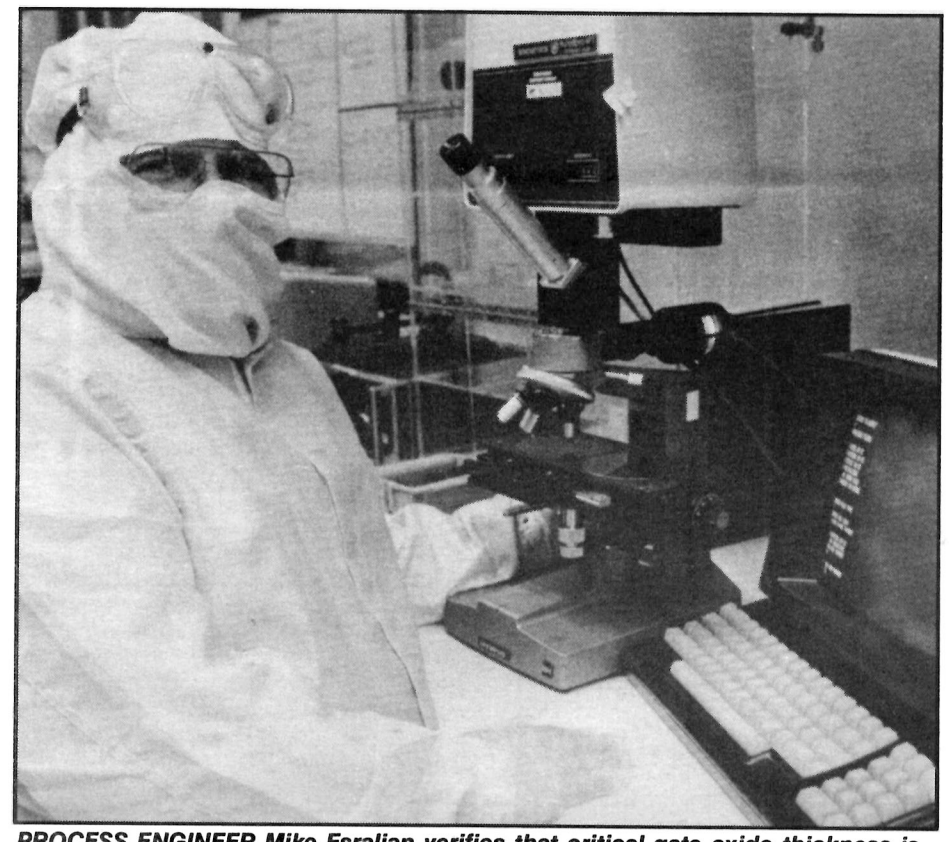


LONG SHOT—This picture of the Globular Cluster Messier 13 was taken May 3 at the Palomar Observatory by Professor J.B. Oke and F. Harris of the California Institute of Technology and Morley Blouke of Tektronix. They used a 512x512 Tektronix charge coupled device (CCD) with a 60-inch telescope. The exposure was 200 seconds in red light. Morley said the area pictured, at a distance of 30,000 light years, contains between 200,000 and 300,000 stars.

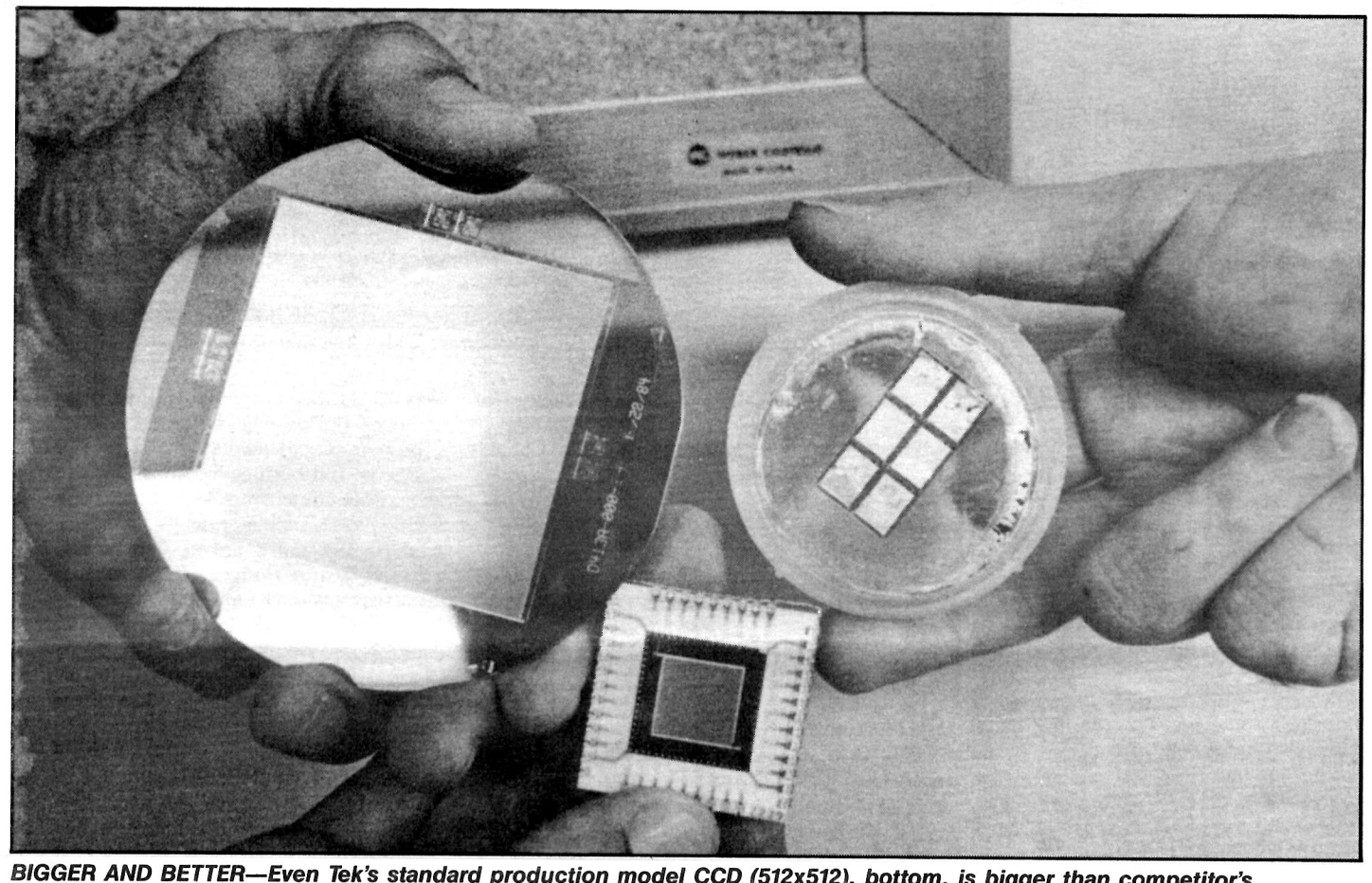


MORLEY BLOUKE, a Tek IC design engineer with a Ph.D. in solid state device physics, is also an avid amateur astronomer. His space connections were, in part, responsible for inspiring Tek's advances in production of charge coupled imaging devices (CCD's) that can be used, among other things, for getting better pictures of space and what's in it.

PHOTO TECHNICIAN Merlina Fagaragan loads CCD wafers into a projection aligner used for printing millions of tiny, precise patterns.



PROCESS ENGINEER Mike Esralian verifies that critical gate oxide thickness is within specification.



BIGGER AND BETTER—Even Tek's standard production model CCD (512x512), bottom, is bigger than competitor's models (at right). Tek's largest model and a world first (left) contains more than 4 million light sensing points (pixels) and offers fascinating potential for some special applications such as astronomical observation. The smaller device, also used for studying the stars, will find more common use in scientific cameras and other down to earth applications.