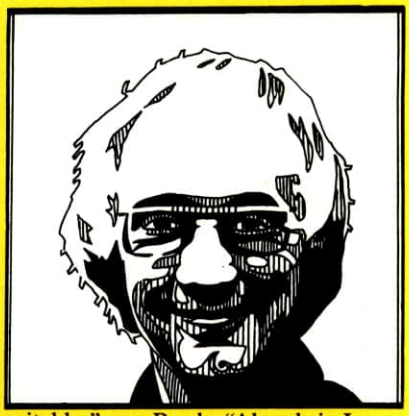
CRYSTAL GAZING'S COLOURFUL FUTURE

By Barry Fox

Winner of the 1987 UK Technology Press Award

THE SCREEN THAT FELL FLAT

Take your pixels – before somebody else does. The deepest frustration belongs to those who toil and sweat and can't get to market.



In 1953 Lord (J. Arthur) Rank, of the Rank Organisation, set up a Foundation to donate prizes for research work done in the two fields which most interested him — nutrition (from Rank's start in flour milling) and opto-electronics (from his later work in the film industry).

This year, one of the prizes was split between seven researchers for their work on liquid crystal tv screens. This is a classic example of a seminal invention being made in the West, but exploited in the Far East.

The pioneering work on lcd screens was done by Thomas Peter Brody, while at Westinghouse in America. He headed a team of thirty who found out how to deposit thin film transistors on a flat panel and so directly address individual cells of a liquid crystal display.

Ten years later research done at the Royal Signals and Radar Establishment at Malvern and the University of Dundee showed that amorphous silicon, as developed for solar cells, was the best material to use for making the thin film transistors. Amorphous silicon is non-crystalline, and much easier to apply evenly over large areas. But neither Malvern nor Dundee had the resources to create panels suitable for the consumer market.

Westinghouse had succeeded, as far back as 1972, in making a 15 by 15cm square panel, with 12,000 elements. Five years later Westinghouse made a panel with 30,000 elements. They were suitable for computer graphics and text. But then the company lost interest in lcd screen technology; the original work had been funded by government military contract and Westinghouse was not interested in consumer applications.

In 1981 Brody left Westinghouse and set up his own company, Panelvision, with sights set on the computer and tv market. By 1984 Panelvision had made a 25cm diagonal display with 256,000 elements, but the company was under-funded. The next year it was bought out by military avionics company Litton Industries. They too were not interested in consumer applications.

By then the Japanese had moved in. The first liquid crystal colour tv screen was made in 1983 by Seiko but the breakthrough came in 1985 when Matsushita (Panasonic) found a way of improving both colour reproduction, and brightness when the picture is viewed off axis. Although obviously bitter about the way Western research has been handed on a plate to Japanese industry for exploitation, Brody is gracious in the way he salutes the Japanese achievement.

"The picture on the Panasonic three inch tv set is as good as you would get from a colour tube," he says.

The Japanese, past masters at production engineering, found a way of accurately mass producing a 7.5cm diagonal screen, made up from 100,000 picture elements divided into triplets of red, green and blue. Most important, they realised the need to tune the thickness of the liquid crystal material to the wavelength of the light.

Because red, green and blue light have different wavelengths, the red, green and blue cells each have different dimensions, matched to the wavelength of red, green and blue light.

Says Brody, "You ain't seen nothing yet — I believe this is the start of another major solid state revolution, comparable to the transistor in economic impact."

I asked Brody about the popular notion that before long television sets will have flat lcd colour panels that you hang on the wall. "In the end that is inevitable," he told me. "But it's a long, long way off. The large screen colour tube will be the last thing to be replaced."

The tv industry clearly shares Brody's faith in the colour tube as we now know it. Sony is investing in expanded tube production at its crt plant at Bridgend, Wales. On the day that three of its lcd engineers shared the Rank prize with Peter Brody, Matsushita announced that it was spending $160 million on a new factory to build cathode ray tube colour screens at Troy in Ohio, USA. This plant will be jointly owned by Matsushita and Philips, under a joint venture deal signed way back in 1952. Significantly, however, tube production at Troy will be centred on 74cm and 84cm crts, rather than the smaller sizes for portable sets which are more likely to be replaced by lcds.

"The future of lcd is in new applications for which tv tubes aren't suitable," says Brody. "Already in Japan they are making two or three million pocket tv sets a year. The next step will be to make pocket sets with larger screens, 13cm diagonal instead of 7.5cm. Then there's the computer market. In three or four years computers will be using colour lcd screens instead of colour tubes."

"It will take that long because remember you are not talking about integrated circuits, where you keep doubling the amount of elements, and all along you have something to sell. Here you have nothing to sell until you have a screen with around 100,000 elements. For high definition computer graphics, you need about 1.5 million lcd elements, half a million blue, half a million red and half a million green, all accurately arranged in triplets.

"Already the Japanese are planning to put a flip down lcd tv screen on each seat in their Bullet train. Airlines are doing the same. In the future every telephone will have one. Although high quality moving pictures won't go down an ordinary telephone line, you can build up still images slowly."

The list of applications is endless. Lcd screens will be used in cars to display engine functions. Already flat panels are being used on aircraft flight decks, for navigation and instrumentation display.

The Panasonic pocket tv, which has 100,000 elements, has been selling in Japan for two years now, for around 60,000 yen (£250). They should be in British shops in time for this Christmas.

Already Panasonic has gone a stage further, by building a tv projector using the same screen display as the pocket tv. A bright light is shone through the lcd panel and the image focussed on a wall screen by a projection lens.

Peter Brody, having seen two employers lose interest and fail in the lcd business, has now started a third company of his own. He acts as a consultant for computer manufacturers, like Apple, which will eventually use lcd screens. Brody is understandably pretty sour.

"There is a saying in America about

Continued on page 18

LEADING EDGE

continued from page 8

how pioneers end up with arrows in their back," he recalls.

Brody has ideas of his own about how to build a very big lcd display. "But I am trying to raise money so I am not yet ready to talk about it."

The oddest part of the story relates to the patents on lcd colour screens.

"Westinghouse filed for a patent on Fisher's idea of putting a thin film of transistors and liquid crystal cells on glass, covering them with colour triplet filters, and viewing the image with transmitted white light, such as a white fluorescent back light," says Brody. "This is what the Japanese are now doing. And they are infringing the Westinghouse patent. Westinghouse say they are not in the panel business so do not want to spend the money on legal action. Our own company, Panelvision, had exclusive rights on the patents and we tried to enforce them. The International Trade Commission in Washington said they would block the import of lcd sets into North America if we could prove they infringed the patents. But Panelvision went out of the lcd business and now no-one is enforcing the Westinghouse patent, even though it has several years left to run."

To add some further detail I searched out the key patent, USP 3 840 695. It was filed by Westinghouse, in October 1972 and granted two years later. Under US law it will remain in force until 1991. It was Westinghouse researcher Albert Fischer who hit on the key idea of coating glass with a thin film matrix of transistors and liquid crystal cells, and covering them with a matching matrix of tiny red, green and blue filters.

Westinghouse claimed in the patent to have solved the problem of providing 750,000 colour cells. But despite spending hundreds of millions of dollars on the project, they never succeeded in making a saleable product for consumer use. PE