Dollars in the crystal

by Joan Arehart-Treichel

The sun rises over the East River, streaking Manhattan's high rises. Robert Saxe, a 38-year-old physicist, leaves his apartment at 80th Street and Park Avenue to catch an early train to Plainview, Long Island. The ride takes an hour through drab, industrialized towns, but Saxe says he doesn't mind because he does some of his best thinking while commuting. When he arrives in Plainview he grabs a cab and heads for a sprawling industrial complex. His destination is six spartan rooms—Research Frontiers Incorporated.

Saxe is president of the four-staff company, its major stockholder and, for all practical purposes, its scientific mastermind. If RFI's secrets can be commercially applied, they could earn Saxe millions of dollars. If the secrets don't pan out, Saxe stands to lose all—eight years of research and $120,000 in personal investment.

Saxe and his staff have figured out how to use crystals in liquid suspension to control light passing through glass. Since there is a widespread need to control light going through glass, their discoveries have all sorts of commercial possibilities—controlling light passing through windows in offices, homes, apartments, greenhouses, poultry houses; windshields in automobiles, trucks, aircraft and other vehicles; sunglasses, welding goggles, watch dials and alphanumeric advertising displays. The discoveries could be used to reduce glare in automobile rearview windows, to change television screen contrast and glare according to the light needs in a room. The discoveries could be applied to camera shutters, theatrical light controls, helmets to protect astronauts against sun blindness. . . .

Whether Saxe and his staff will be able to bring any or all of this off depends on his capabilities as scientist-businessman—a hybrid that was common during the economic and scientific heydays of the 1960's but is not so common in these days of economic retreat, scientific disfavor and fewer returns on the research dollar. Saxe is scientist-entrepreneur—a scientist trying to exploit science on his own, for profit.

After getting a bachelor's degree in physics from Harvard in 1956 and a master's degree in business administration from Harvard in 1960, Saxe did marketing research for a glass company, then worked as a security analyst on Wall Street, making enough money to launch RFI in 1966.

RFI started developing inventions for licensing to others, but there were problems, as a president who mismanaged the company causing large financial losses and a legal suit against two licensors. By 1969 Saxe had been educated in science-entrepreneurship to the tune of three-quarters of a million dollars. But Saxe was now president, and he decided that he and his staff would tackle one problem only—unlocking the secrets of light control that Edwin Land, inventor of the Polaroid camera, gave up trying to unlock some 40 years ago.

During the past five years, Saxe claims, he and his staff have unraveled those secrets, mastering complex interactions of physics, physical and colloidal chemistry, optics and electronics. Saxe has filed a slew of patent applications to protect their discoveries, and they have made prototype products based on their discoveries—a window that, at the press of a button, cuts its light transmission up to 95 percent; a television screen filter than can be altered to the lighting conditions in a room; alphanumeric displays that have better contrast and visibility and take less energy to operate than those on the market.

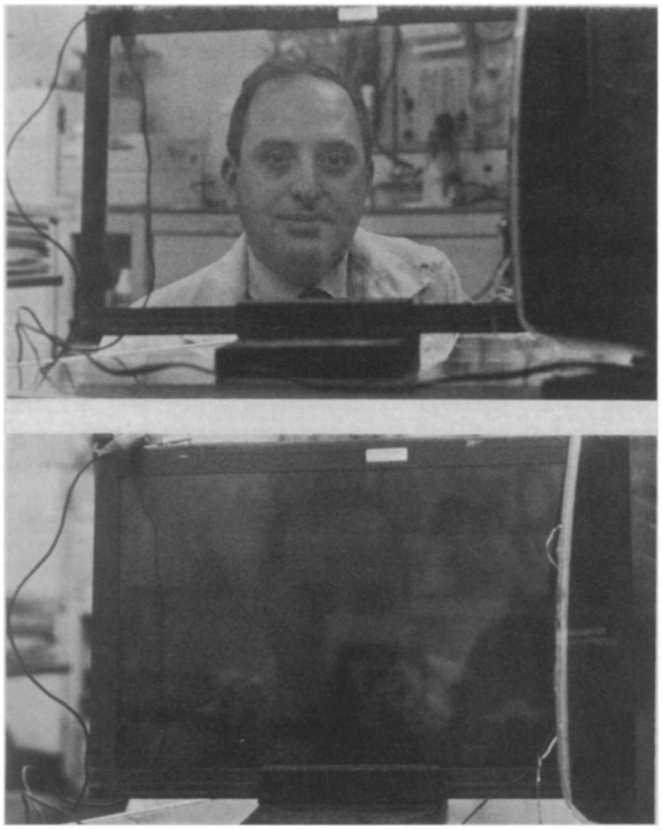
The principles that Saxe and his staff have arrived at are actually based on work that goes back a century. An English chemist put iodine in the urine of a dog that had been fed quinine; green crystals known as herapathite formed in the urine. The scientist noted that the crystals were able to filter out light. Then in the late 1920's Edwin Land decided to see whether herapathite crystals might be used to control light passing through glass.

He took two sheets of glass, coated their inner sides with electrically conductive, transparent material, then placed the two sheets together, a fraction of an inch apart. He filled the space between the sheets with a liquid suspension of herapathite crystals (millions of them, too small to see without a microscope). The crystals did what Land anticipated—they moved randomly through the liquid, as if they were doing a dance. The reason they moved haphazardly is that they were being bombarded by the molecules of liquid in which they were suspended. This molecular bombardment, characteristic of colloidal suspensions, is known as Brownian motion. So while the crystals jumped about, they absorbed light and kept it from passing through the glass sheets.

Then Land applied a powerful magnetic field to the crystal suspension. The field caused the particles, which were needle-shaped, to orient their long axes parallel to the field and perpendicular to the glass sheets. Since the ends of the crystals had less area to block light than the sides of the crystals, the alignment of the crystals end to end allowed light to pass through the glass sheets. When Land took the magnetic field away from the crystal suspension, the crystals returned to their job, and light could no longer pass through the glass.

On the basis of these discoveries, Land patented the first fluid suspension light valve that could use either a mag-

There is a universal need to control light passing through glass. This scientist is convinced that crystals are the answer.



Saxe in his lab (left). Saxe can be seen through his television filter because crystals in the filter have aligned, letting light through (top right). Saxe can hardly be seen through the filter because the crystals in the filter move randomly, blocking light (bottom right).

Arehart-Treichel

netic field or an electrical field for light control.

But Land had problems that had to be overcome if his light valve concept was to be commercially feasible. For one, alternating current voltage that was necessary for the crystals to align also caused them to agglomerate (clump), making visible dots in the glass and interfering with vision through the glass. It was impossible to use low-frequency electricity, which is convenient and widely available, because it enhanced the clumping problem. The herapathite crystals were not stable enough to be used in hot climates. Nor was the range of light transmission good because of the nature of the fluid suspension that Land used. There was also a potential problem in applying the light valve to large vertical sheets of glass—the pressure of the crystal suspension against the sheets would have made them bulge slightly.

Land gave up the idea of trying to use a crystal suspension to control light passage through glass, and in the 1950's his early patents passed into the public domain. In 1969 Saxe and his staff picked up where Land had left off.

Saxe says that they have now solved the problems that Land did not resolve. They have found a number of stable, needle-shaped crystals that align without clumping. They have a wide range of inorganic and organic materials they can use for suspensions that allow light to go from almost 100 percent opacity to perfect transparency. They have overcome the problem of the glass sheets bulging. They can control the passage of light with the same low-frequency power supplies that small appliances use, making crystal control of light economically feasible.

A crucial problem Saxe and his staff had to overcome was finding the right kinds of compounds to do the job. They had literally thousands to choose from. What they did was see through various problems and stay away from the compounds that might have been dead ends. "It was Sherlock Holmes kind of work," Saxe says. "If there has been any thread to my career, it's problem-solving."

A major company has taken out an option to license RFI's light valve, that is, see whether the valve might be applied to its products. A number of other companies are interested. Whether they turn RFI's discoveries into commercial products or not will decide whether Saxe and RFI will reap financial rewards.

Whether Saxe and RFI make it or not—Saxe believes they will—his efforts point up some of the things it takes to be a scientist-entrepreneur in the 1970's. Saxe has chosen an area of research that offers unlimited growth—electro-optics. For decades the world's leading glass, optics and electronics companies have been seeking a simple means to control the quantity and quality of light. In the United States alone, some two-and-a-half billion square feet of flat glass are sold annually for windows and other purposes. If incorporated in this glass, the RFI light valve could eliminate the need for blinds and shades and might well control heat as well as light in rooms.

Unlike many small science companies, which rise and fall with one industry, Saxe and RFI have knowledge that can be marketed to many industries. In fact, one of the spin-offs from their colloidal chemistry knowledge is an auto pollution control device, which they are now trying to patent. Saxe is good at business; the money he has invested in RFI he made on Wall Street in securities. He has sold himself and his company to outside investors—wealthy family friends and a venture capital firm, Rand Capital Corporation of Buffalo. Today less than one percent of small business people seeking venture capital find it. He is tapping outstanding professional talent to supplement the efforts of his small staff.

Most crucial, today's scientist-entrepreneur must live his work. Saxe hasn't yet solved any problems in his dreams, but he keeps a 27-pound crystal on his apartment coffee table for inspiration. Saxe says he wouldn't mind getting rich, but he could have done that on Wall Street. "What I want," he says, in the tradition of many American scientists, "is to combine science and business in a useful way." □