Bienenstock on Ovshinsky

In the mid-1960s, Stan had an enormous impact on physics with the announcement of two types of devices. Both involved conductors with a thin sheet of amorphous material in between. By applying pulses of one sort, he could transform that thin sheet from a highly resistant material to a highly conducting material. It was known as the threshold switch. It would have a very high resistance until a certain voltage was reached, and then it would switch to a highly conductive state.

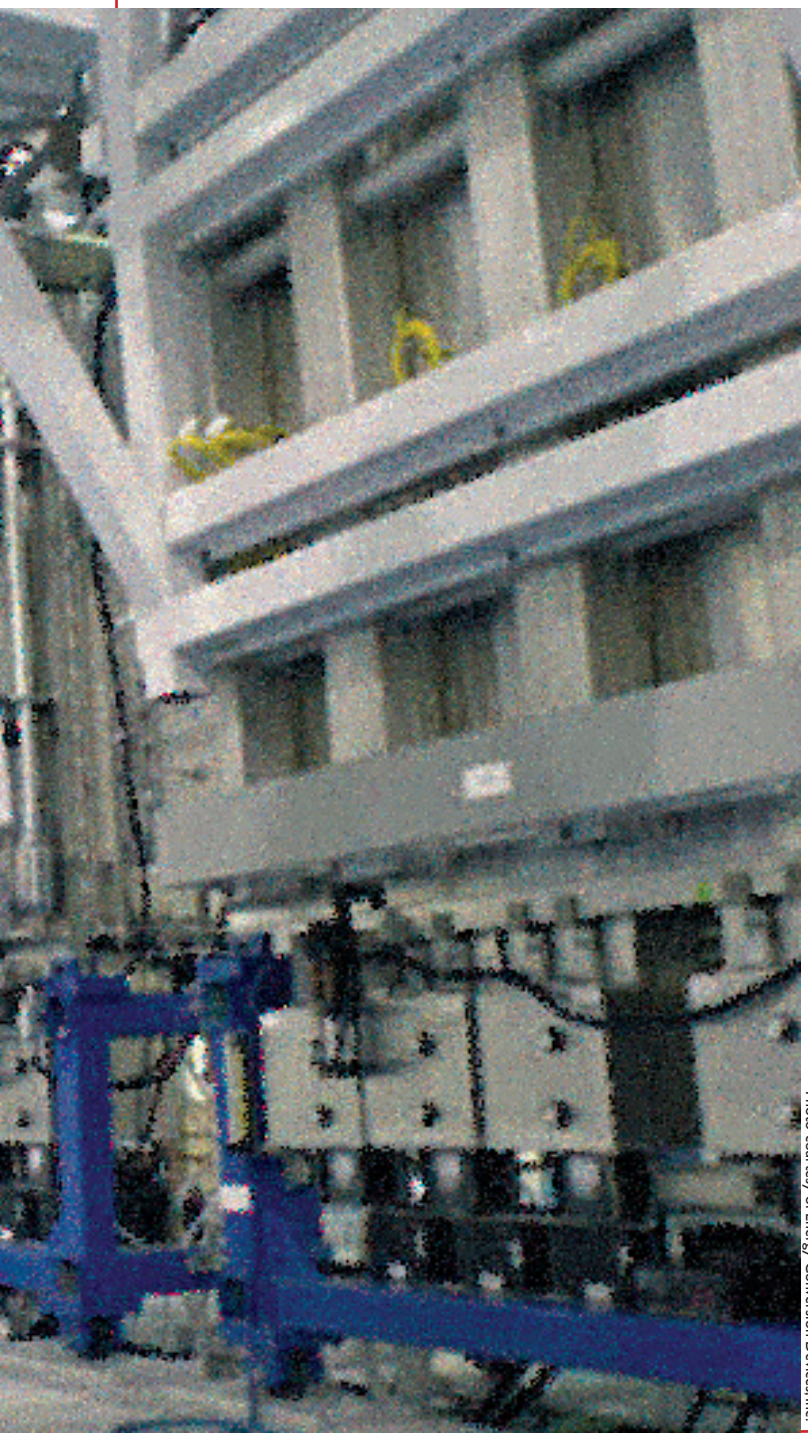

Photo courtesy of Energy Conversion Devices, Inc.

The second device was a memory device. Again, it involved switching from a high-resistance state to a lower resistance state, but this time, you could keep it in either the high- or the low-resistance state without the application of an electric voltage. Those two devices got the field of amorphous semiconductors going. At first, no one believed that you could go back and forth between a high- and low-resistance state as rapidly as Stan was claiming. And Stan was also claiming that it was a transition back and forth between a crystalline state, in which the atoms are highly ordered, and an amorphous state, in which the atoms are ordered pretty much like a liquid. Stan was subsequently proven to be right, however, and the field progressed.

Soon after, Stan showed that you could switch these materials with the application of light and, in particular, lasers. This technology is the basis of the CD-RWs and the DVD-RWs used in computers. They're all based on the type of memory materials that Stan developed.

At the same time, Stan was making fundamental contributions to the field of amorphous materials, throwing ideas out just left and right. I can recall being on a plane with the Nobel Laureate Sir Nevill Mott, who got his Nobel Prize for working in this field; he said, "A lot of my best ideas came from Stan. He just gave them away to me." And all of us in the field have had that experience.

Stan's next project was using amorphous silicon to make photovoltaics. He made fundamental contributions that converted it from a lab phenomenon to something that became commercial, ending with production plants that manufacture photovoltaic sheets about a yard wide and a mile or so long that you can slice up to put on roofs and the walls of buildings. This development dramatically changed the photovoltaic field from something that powered little calculators to something that could produce lots of power.

I think it was in the 1980s that Stan developed the electrodes for the nickel metal hydride battery. Before that, people were trying to make pure, single-phase electrodes; Stan brought disorder to the field, putting many elements into the battery so that the crystals were very small. This allowed the capacity of the batteries to become so high that they could be used for all of the nickel metal hydride cells that you have in your computers and also in hybrid automobiles. He used the same ideas to advance hydrogen storage — in solids, not in gas tanks — and in fuel cells.

Arthur Bienenstock is Special Assistant to the President for Federal Research Policy at Stanford University, where he is a professor at the Stanford Synchrotron Radiation Laboratory and in the Departments of Applied Physics and Materials Science and Engineering. He is President of the American Physical Society and has served as Associate Director for Science of the White House Office of Science and Technology Policy. He has collaborated with Stan Ovshinsky since 1965.