

A modest man's big idea Digital chip changed the world

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Wallace, N.S.—Many people just dream of changing the world; Nova Scotia physicist Willard (Bill) Boyle is one of those rare people who can honestly say he did.

But he has to be pushed to admit it, and even then he acknowledges the magnitude of his achievement with a slightly embarrassed shrug and a smile.

Boyle is the co-inventor, along with American George E. Smith, of the CCD or "charge-coupled device."

That's a deceptively modest name for the little flat silicon chip that allowed human beings, for the first time, to capture and store light as digital data — and has ultimately changed the way we see the universe.

Few of us have not used the invention. It is the basis for a seemingly endless list of technologies: digital cameras, camcorders, fax machines, photo-copiers, bar code readers, high-definition television, advanced medical instruments and Internet communication networks.

It has also made modern astronomy possible; space telescopes, including the Hubble, all use CCDs.

"I guess we can look at its use in both ends of human endeavours," says Boyle. "It has expanded our view of the universe by a factor of three or 10, depending on how you count it.

"And," he adds with a chuckle, "I also got a note from a doctor in Scotland who wanted me to write a foreword to his book on colonoscopy. It is used for that, to make it less painful. So the CCD is very versatile."

William Wulf, president of the U.S. National Academy of Engineering, describes the invention of the CCD as "an achievement that has had an incalculable impact on our society."

On Feb. 21, at a gala in Washington, the academy will award Boyle and Smith engineering's highest honour, the prestigious Charles Stark Draper Prize for achievements that "advance human welfare and freedom."

Boyle and Smith will share \$500,000 (U.S.)

Sitting in his waterfront home overlooking Lazy Bay, Boyle reflects on what spurred him and Smith to develop the CCD at Bell Labs in New Jersey.

The year was 1969, and Boyle was working under high-pressure boss Jack Morton, who headed advanced research. Morton regularly reminded Boyle that Bell Labs researchers had already won three Nobel prizes, for inventing the transistor, and that more were expected.

"He would call up maybe twice a week and ask what we were doing in the semi-conductor device work. And I would say 'not much,'" Boyle recalls.

It was after just such a phone call that Boyle and Smith sat down to brainstorm. "George and I had been kicking around all sorts of ideas about storing an image on a silicon chip," he says. It took the two men about 45 minutes of sketching the structure on a blackboard to come up with one of the most influential inventions of our times.

Apart from several international awards scattered around Boyle's house, there is little in this comfortable and unostentatious home — or in his self-effacing demeanour — to hint at his illustrious scientific career. Boyle says he retired to Wallace on the Northumberland Strait because of his roots; it is where he was born in 1924. He was 3 when his father, a doctor, moved to Quebec to run a bush hospital in an isolated logging camp some 350 kilometres north of Montreal. Boyle, an only child, credits his mother Beatrice, a nurse, with fostering his scientific curiosity.

He recalls that when he discovered he could produce great flashes of light by attaching wires to a shiny mineral called molybdenite, which was being blasted out of the rocks in the river by the logging company, he would chase after lumberjack friends with his invention, saying "Hey, look at this!"

At 14, Boyle went off to Lower Canada College in Montreal, then on to McGill to study physics. His university education was interrupted in 1943, when he joined the Royal Canadian Navy. Later loaned to the Royal Navy, he was learning to land Spitfire fighters on aircraft carriers when World War II ended.

Back in Canada, he completed his PhD at McGill then spent a year at Canada's Radiation Lab and two years teaching physics at the Royal Military College, before moving to Bell Labs.

"You know it was just fun to be there," says Boyle. "You had a model lab and could make anything you wanted, no matter how sophisticated. It was right at the forefront of the technology. It was a pressure cooker — you produced or else. But it was the luckiest thing that ever happened to me."

Among his many accomplishments was the first continuously operated ruby laser. As a result, for a time he was farmed out to NASA, where he helped choose where Apollo 11 would land on the moon in 1969.

"I think most of the really big ideas come not from people in tiny little boxes but from people who are broadly educated in their field, so they understand it in depth," he says. "That's where the possibility for real innovation takes place."

Despite his scientific renown, here in the rural community in northern Nova Scotia where he settled when he retired 26 years ago, Boyle — along with his wife Betty, a landscape artist — is better known for the small art gallery they helped to launch.

He seems quietly amused at the sudden flurry of media interest in him. He seems every bit as happy talking about his new passion, photography and manipulating digital photographs that adorn his walls, as he is about his invention of the CCD that made it all possible.