The Road to the Transistor

By Jed Margolin

The transistor was invented in 1947 at Bell Labs by the team of John Bardeen, Walter Brattain, and William Shockley, for which they later received the Nobel Prize. The first transistor was a germanium point-contact transistor consisting of two thin electrodes in point-contact with the surface of a piece of germanium and with a third wire attached to the base.

Many of the early experiments consisted of breaking open a point-contact germanium diode and, by trial and error, finding a place where the third wire could be attached so the device would have a gain greater than one. [IBM Reference] At the time, in 1947, germanium as well as silicon point-contact diodes had been available for several years, and therein lies a tale.

It started in 1906.

1906 was one of those years that would shape the world for years to come, although few people, if any, realized it at the time. In October 1906, Greenleaf Whittier Pickard (the grandnephew of the poet John Greenleaf Whittier) received a patent on a method for receiving radio signals that included a silicon point-contact diode. {U.S. Patent 836,531 was filed on August 30, 1906 and issued November 20, 1906} Shortly afterwards, Henry Dunwoody received a patent on a system using a point-contact detector made of carborundum (silicon carbide). {U.S. Patent 837,616 was filed on March 23, 1906 and issued December 4, 1906}.

These detectors were far superior to what was being used. Before 1906 a radio system (or wireless telegraph as it was called) had a transmitter consisting of an inductor that was charged with current and then allowed to discharge across a gap (the spark-gap). One side of the spark-gap was grounded and the other side was connected to the aerial which was as long and as high as possible. The receiver also used an aerial (which was as long and as high as possible) which was connected to a device called a coherer.

The coherer, developed by Edouard Branly in 1890, was a glass tube loosely filled with metal filings and with contacts on each end connected in series with a battery and some kind of signaling or recording instrument. Normally the metal filings were too loosely packed to conduct current, but when an electromagnetic signal reached the coherer the metal filings would coalesce (cohere) and current would flow through the circuit to actuate the signaling or recording instrument.

Unfortunately, when the signal stopped, the metal filings did not return to their non-conducting state so the tube had to be tapped to be made ready for the next signal. Advanced coherers used the recording device to actuate a small hammer to perform the tapping.

The coherer was not very sensitive; it is amazing that such a bizarre device worked at all, but it was this device that was used as the detector when Marconi bridged the Atlantic in 1901. (Of course, his antenna was 400 feet long at the end of a kite.) You can see this in Marconi's U.S. patent {U.S. Patent 586,193 which was filed on December 7, 1896 and issued July 13, 1897. This was the U.S. version of his famous British patent number 7,777.}