



(L-R) Shockley, Bardeen & Brattain in Brattain's lab, 1948

## Switched Off

*I am overwhelmed by an irresistible temptation to do my climb by moonlight and unroped.*

Mountaineer William Shockley on his secret work on the transistor, 1947

**H**IS NAME IS ENSHRINED ALONG-side other legends of Silicon Valley, like Bill Gates, Steve Jobs, Andrew Grove, Robert Noyce, and Gordon Moore.

He was awarded a Nobel prize for his invention of the electronic transistor, the precursor to the integrated circuits that made possible our modern, digital world. His name?...William Bradford Shockley, Jr.

The only problem with this fabled story is that it is just that: a fable.

Shockley wasn't in fact the inventor of the transistor. Two far less well-known men were: John Bardeen and Walter Brattain. And just how this injustice came to be is the story of one man's unbridled ego and hubris.

Shockley, Bardeen, and Brattain were members of a solid state physics research group which formed at Bell Labs in New Jersey after the second World War. Their task was to find a viable solid state replacement for fragile, expensive, and cumbersome vacuum tube amplifiers.

Initial attempts—centered on a ‘field effect’ theory favored by Shockley—failed to pan out, and the group was stymied until Bardeen proposed a different ‘electrolyte-based’ approach, which, with help from Brattain, ultimately proved fruitful.

All three men immediately recognized the significance of the invention, but despite having had no part in the other two men’s work, Shockley felt that his earlier design had been crucial to the breakthrough, and as the leader of the group he was outraged that his name did not appear on the patent.

Shockley even attempted to have the two other men's names replaced with his, and after he blocked them from further work on the transistor, they refused to work with him.

While Bardeen's 'point-contact' transistor was a workable design, Shockley felt that it would be too costly to manufacture, and continued to work in secret on what he hoped would be a more commercially viable design.

In 1951, he modified the 'sandwich' structure design of another under-appreciated team member, John M. Shive, and created the 'junction' transistor, which would evolve into the familiar 'bipolar sandwich' design utilized in the vast majority of early solid state devices, ushering in the Computer Age.

Unlike Shockley, Bardeen and Brattain had unassuming personalities, but they felt alienated by Shockley's attempt to usurp credit for inventing the transistor. (At one point he even claimed that the other two had contributed nothing to the discovery.)

Bell Labs consistently presented them as a team, and all three were awarded the Nobel Prize in Physics in 1956, but the famous photo the lab circulated to the press still suggests Shockley was the main developer.

Shockley left Bell Labs in 1953 to found Shockley Semiconductor in California. Once again he hired the best researchers in the field, no small achievement considering that by this time he had a reputation as a domineering, temperamental manager.

When Shockley unilaterally decided to discontinue research on silicon-based semiconductors in 1957, eight of his most valuable researchers resigned en masse.

The so-called 'traitorous eight' (which included Gordon Moore and Robert Noyce) went on to found Fairchild Semiconductor and Intel—seminal firms in what would later become known as 'Silicon Valley.'

(Shockley's company never recovered from this mass defection, and would be bought out by another company three years later.)

Shockley shocked the scientific world again in the 1960s by publicly endorsing racism and eugenics, the belief that some races are genetically inferior to others.

Arguably, he was a victim of what is informally known as 'Nobel Disease'—the tendency of some prize winners to promote scientifically unsound ideas outside the scope of their expertise late in their careers.

Shockley's embrace of eugenics and his advocacy of sterilization for 'genetically inferior' people was, however, far more damaging than the preoccupations of other scientists afflicted with the malady—for instance, Linus Pauling's harmless advocacy of Vitamin C to ward off the common cold.

The resulting outcry and public protests ultimately destroyed Shockley's scientific credibility. (It didn't help that, nonsensically, Shockley fended off charges of racism by claiming that while blacks were indeed less intelligent than white people, Asians and Jews were intellectually superior to both.)

Bardeen and Brittain both went on to enjoy successful late careers (Bardeen, who has been compared to Albert Einstein, won a second Nobel Prize in 1972 for his work in superconductivity), but Shockley's later years were marked by chronic depression. (He reportedly once attempted suicide by playing 'Russian roulette.') When he died in 1989, he was estranged even from his family.

An accomplished climber, Shockley's route through a ridge in Upstate New York is named 'Shockley's Ceiling' in his honor.

Ironically, one could say that William Shockley reached his own 'ceiling' of sorts with the Nobel Prize, and—as the saying goes—it was all downhill from there. ■