= John N. Shive =

John Northrup Shive (February 22 , 1913 ? June 1 , 1984) was an American physicist and inventor . He made notable contributions in electronic engineering and solid @-@ state physics during the early days of transistor development at Bell Laboratories . In particular , he produced experimental evidence that holes could diffuse through bulk germanium and not just along the surface as previously thought . This paved the way from Bardeen and Brattain 's point contact transistor to Shockley 's more robust junction transistor . Shive is best known for inventing the phototransistor in 1948 , a device that combines the sensitivity to light of a photodiode and the current gain of a transistor , and for the Shive wave machine in 1959 , an educational apparatus used to illustrate wave motion .

= = Early life and education = =

John N. Shive was born in Baltimore , Maryland , on February 22 , 1913 , and grew up in New Jersey . Shive graduated from Rutgers University with a B.S. in physics and chemistry in 1934 . He also earned a Ph.D. from Johns Hopkins University , submitting a dissertation Practice and theory of the modulation of Geiger counters in 1939 . Shive became a fellow of the American Physical Society , a member of the American Association for the Advancement of Science , and was a member of the Phi Beta Kappa and Sigma Xi fraternities .

= = Scientific career = =

John N. Shive joined Bell Telephone Laboratories in 1939 . Shive worked initially on physical research , device development and later on education and training . After retirement from industry , he worked as an adjunct professor of physics at Georgian Court University . The spherical sundial on campus , in front of the bookstore and next to the library , is dedicated to his memory for his lifelong desire and service toward improving the teaching of physics .

= = = Transistor development = = =

On January 30 , 1948 Shive discovered that gold @-@ plated tungsten point contacts on a p @-@ type layer of germanium grown on an n @-@ type substrate gave " a terrific triode effect . " On February 13 of the same year he also discovered that a transistor consisting of bronze contacts on the surface of an n @-@ type substrate without a p @-@ layer gave " gains up to 40 × in power ! " He leveraged this discovery to build a point contact transistor with bronze contacts on the front and back of thin wedge of germanium , proving that holes could diffuse through bulk germanium and not just along the surface as previously thought . This confirmed William Shockley 's idea that it should be possible to build a junction transistor , an idea that hitherto he had kept secret from the rest of the team . Shockley later admitted that the workings of the team were " mixture of cooperation and competition . " He also admitted that he kept some of own work secret until his " hand was forced " by Shive 's 1948 advance .

= = = Phototransistor = = =

In 1948 Shive invented the phototransistor that used a beam of light , instead of a wire , as the emitter of a point contact transistor , generating holes that flow to the collector . It wasn 't announced until 1950 . This invention embodies the modern day nationwide direct distance dialing system .

= = = Shive wave machine = = =

Shive was a gifted lecturer and became Director of Education & Training at Bell Telephone Laboratories . In this role he was responsible for curriculum and administration of educational

programs provided to employees of Bell Laboratories .

In this new role , he invented the Shive wave machine (also known as the Shive wave generator) . The wave generator illustrates wave motion using a series of steel rods joined by a thin torsion wire . The torsion wire transmits energy from one rod to the next . The high moment of inertia of each rod ensures the wave takes several seconds to traverse the entire series of rods , making the dynamics easily visible . The motion is analogous to high @-@ frequency waves that are invisible to the human eye , such as electromagnetic waves on a transmission line . The wave generator could illustrate wave reflection , standing waves , resonance , partial reflection and impedance matching . Shive made two educations films in which he demonstrated the machine , Simple Waves and Similarities in Wave Behavior , and wrote a book with the same name as the latter . Exploratorium Exhibit Services manufactures a large scale version of the machine for use in science museums .

= = = Patents = = =

Shive held several patents including Selenium rectifier and method of making it , Directly heated thermocouple , Photoresistive translating device , Selenium rectifier including tellurium and method of making it , Apparatus for and method of treating selenium rectifiers , Semiconductor photoelectric device , Conditioning of semiconductor translators , Semiconductor amplifier , and Alternating gate current .

= = = Books = = =

Shive authored three books during his career , beginning with The Properties , Physics , and Design of Semiconductor Devices (1959) , a book about semiconductor devices . This was followed by Similarities of Wave Behavior (1961) , a book designed to help college professors teach students about waves using the machine he invented . His last book , Similarities in Physics (1982) , was coauthored with Robert L. Weber . He was also one of the editors of Transistor Technology , Volume 1 .

= = = Honors = = =

John N. Shive was a fellow of the American Physical Society and a Senior Member of the Institute of Electrical and Electronics Engineers . He was also a chairman of the Advisory Committee on the Pre @-@ College Physics Project of the American Institute of Physics .

= = Personal life = =

Shive was married to Helen Shive .

= = Selected works = =

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