

OBITUARY

Julius Axelrod **(1912–2004)**



Julius Axelrod, American neuroscientist and a Nobel laureate died at the age of 92 on December 29, 2004 at Rockville, Maryland, USA.

Born on May 30, 1912 of Galician Jewish parents, Julius Axelrod had been brought up in New York's poor Lower East Side of Manhattan. In his early teens, he was a good but not an outstanding student at school. He decided to study medicine as a route to research. With a first in chemistry and biology from the City College, New York, he applied for admission to medical school in 1933. A poor Jew with uncertain grades in Latin and mathematics, Julius was rejected. That left him jobless during the great depression.

Beginning in 1933 as an unpaid volunteer at the Harriman Research Laboratory at New York University Medical School, Axelrod earned a paid job of a laboratory assistant in the bacteriology department. In 1934, an exploding ammonia bottle blinded him in one eye. In 1935, the Harriman Laboratory closed down. However, Axelrod found the job of a chemist in the Industrial Hygiene Laboratory of New York City Department of Health. There his job was to analyse and develop reliable tests for vitamin concentrations and to check, among other things, the veracity of commercial labels on food products. He worked there for a decade apparently quite contented. He married Sally Taub in 1938. He received a master's degree from New York University in 1941.

He continued to dream of real research. The opportunity came on Lincoln's birthday in 1946, when he walked into the Goldwater Memorial Hospital, New York to join Bernard Brodie. In 1948-1949, Brodie and Axelrod reported that paracetamol was a major metabolite of the well-known antipyretic and analgesic agents, acetanilide and phenacetin, and further established that paracetamol itself is an antipyretic and analgesic agent.

In 1949, Axelrod accepted the position of a research chemist at the National Heart Institute (NHI), a part of the rapidly expanding National Institutes of Health in Bethesda, Maryland. In 1954, Axelrod took a year off to complete his doctorate from the George Washington University, and also initiated pioneering research on lysergic acid diethylamide (LSD) metabolism in the brain. Thus, three things together – the doctoral degree, his new research on LSD metabolism, and his profound knowledge of chemistry - allowed him to kick off his own research programme at the Institute of Mental Health under the National Institutes of Health in 1955.

He rejected promotion to stay active in research and plunged head-on into the chemistry of brain function and malfunction. In the next decade, Axelrod unravelled the metabolism

of biogenic amines in the brain, identified and isolated key enzymes, demonstrated the function of L-DOPA, and confirmed the reuptake of neurotransmitters. In 1970, he shared the Nobel Prize in Physiology or Medicine with Ulf von Euler and Sir Barnard Katz (*see Indian J Physiol Pharmacol* 48: 132-136).

Axelrod was chief of the National Institute of Mental Health's Pharmacology Section from 1955 until he retired in 1984. He maintained his research activities till his retirement and beyond. After retirement he became a guest researcher at the NIH Laboratory of Cell Biology and widened his research interest to the function of the membrane in cell signalling, and the biochemistry of the pineal gland.

Referring to Julius Axelrod, two quotations are illustrative of his character. The first one is his own. Once Julius Axelrod said, "In science, the accepted interpretations are usually wrong. Find and fill an important gap and you may change the whole picture". The second quotation was used by Julius right at the beginning of his classical paper published in *Science* [Axelrod J, Reisine TD (1984) Stress Hormones: Their Interaction and Regulation. *Science* 224: 452-459]. It was a quote from Claude Bernard, "The constancy of the 'milieu interieur' is the condition of a free and independent existence". The key expressions that personify Julius Axelrod in these two quotations are: *change the picture*, and *free and independent existence*. Through his free and independent existence, Julius Axelrod indeed helped change the picture of modern neurochemistry.