# Godfrey Newbold Hounsfield (1919–2004): The man who revolutionized neuroimaging

**Kalyan B. Bhattacharyya**

Department of Neuromedicine, RG Kar Medical College and Hospital, Kolkata, West Bengal, India

**Abstract**

Godfrey Hounsfield, a biomedical engineer contributed enormously towards the diagnosis of neurological and other disorders by virtue of his invention of the computed axial tomography scan for which he was awarded the Nobel Prize in 1979. Working for the Electrical and Musical Industry (EMI) Limited and in collaboration with two radiologists, James Ambrose and Louis Kreel, he introduced the use of this machine in 1971 at the Atkinson Morley's Hospital in Wimbledon. He continued to improve the quality of the devise and the human head was scanned for the first time in 1972. He continued his work on imaging of the human body was later concentrated on the next step in diagnostic radiology namely, magnetic resonance imaging.

**Key Words**

CT scan, EMI, hounsfield

**For correspondence:**
**Prof. Kalyan B. Bhattacharyya,** Amrapali Point, Flat 1C, 59F, Bosepukur Road, Kolkata - 700 042, West Bengal, India.
E-mail: kalyanbrb@gmail.com

*Ann Indian Acad Neurol 2016;19:448-450*

In the long and tortuous course in the evolution of the history of medicine, quite a number of individuals belonging to other fields of science have contributed substantially toward the growth and advancement of medical sciences over the ages. However, none shines with brighter effulgence than Godfrey Newbold Hounsfield, the biomedical engineer and inventor of the computed axial tomography scan (CAT scan), perhaps with the possible exception of Wilhelm Roentgen, the discoverer of the X-rays and the first ever recipient of Nobel Prize in Physics in 1901. Hounsfield's stupendous work on CAT scan virtually changed the entire face of medical sciences, both in the domain of diagnosis and therapeutic interventions.

Hounsfield was born in Sutton-on-Trent, Nottinghamshire, England, in 1919. Since his childhood, he displayed an uncanny interest in fiddling with electrical gadgets and machineries. He could repair the farm's machines and binders and built a homemade recording machine, and in his Nobel Lecture, he said "*I made hazardous investigations of the principles of flight, launching myself from the tops of haystacks with a home-made glider; I almost blew myself up during exciting experiments using water-filled tar barrels and acetylene to see how high they could be propelled. It may now be a trick of the memory but I am sure that on one occasion I managed to get one to an altitude of 1000 feet!*"[1,2] He attended the Magnus Grammar School in Newark-on-Trent and is reported to have lacked any special intellectual excellence, and his career was thus not studded with glittering distinctions. He joined the Royal Air Force just before World War II and learned the basics of electronics and radar science there. After the war, he received a diploma from the Faraday House Electrical Engineering College in London, partly owing to the munificent gesture of Air Vice-Marshal Cassidy who helped him to get a grant to study there. In 1951, he began working at the Electrical and Musical Industry (EMI) Limited, where he

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**How to cite this article:** Bhattacharyya KB. Godfrey Newbold Hounsfield (1919-2004): The man who revolutionized neuroimaging. Ann Indian Acad Neurol 2016;19:448-50.
**Received:** 21-03-16, **Revised:** 04-09-16, **Accepted:** 04-09-16

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researched on guided weapon systems and radar and spent his entire active life with that company. There, his interest in computers grew and in 1958, he helped in designing the first commercially available all transistors computer made in Great Britain, named the EMIDEC 1100.[1] In 1967, when EMI started losing interest in Hounsfield's projects, his supervisors enquired whether he had anything to pursue; whereupon he told them that for quite some time, he had been toying with the idea of developing a computer software to compile X-rays of an object from various angles and organize them into a three-dimensional representation to help physicians to see the inside of the human body. The British Department of Health and Social Services could foresee some future in the project and provided him with a grant, and within a few years, Hounsfield designed and constructed a CAT scanner after enrolling two radiologists, James Ambrose and Louis Kreel, who assisted him in understanding the fundamentals of radiology and also provided tissue samples and test animals for experimental scanning.[1,3-5] In 1971, a test machine was installed at the Atkinson Morley's Hospital in Wimbledon, and the device was first tested on a preserved human brain and then on a fresh cow brain procured from a butcher's shop, and finally, he chose himself as the ultimate experimental participant.[1] This reminds one of John Hunter, transmitting syphilis on himself to study its clinical features or John Walshe, testing the toxicity of penicillamine in his own urine. In September 1971, CAT scanning was introduced into medical practice with the documentation of a cerebral cyst in a participant at Atkinson Morley Hospital.

CAT scanning turned out to be a highly successful diagnostic tool, and the first production model followed 1 year later. This invention was hailed as a great advance in the diagnosis of structural lesions inside the brain, and it replaced the more aggressive, cumbersome, and invasive procedures such as pneumoencephalography or carotid angiography which were in vogue for visualizing cerebral pathology.[1,3] As head of EMI's medical systems section, Hounsfield continued to improve the device with an aim to lower the radiation exposure, sharpen the images, and develop larger models, which could image other parts of the body as well. Thus, the head scanner came into practice in 1972, which led the City University of London to grant him an honorary doctorate degree in the same year.[1,2] Thereafter, a body scanner was devised in 1975 at the EMI limited, and in 1986, he became a consultant to Thorn EMI Limited Central Research Laboratories in Middlesex near his longtime home in Twickenham. He continued to improve CAT scanner in that capacity and worked hard to develop a version which could take an accurate image of the heart between beats. Thereafter, he concentrated on the next step in diagnostic neuroradiology, namely, nuclear magnetic imaging or what is now termed as magnetic resonance imaging.[1-3]

Hounsfield and the EMI earned more than thirty awards for this outstanding innovation, including the MacRobert award, which is the highest honor for engineering conferred in Great Britain.[2,3,5,6] He was elected Fellow of the Royal Society in 1975, received the Lasker award the same year, and was conferred commander of the British Empire in 1976. In 1979, he was awarded the Nobel Prize which he shared with the South Africa-born American Physicist, Allan McLeod Cormack, who had independently developed the equations pertaining to CT scanning by working on theoretical mathematics involved in reconstructing an image with the aid of the computer, though he could not pursue in his endeavor owing to pecuniary limitations. A curious feature is that neither of them possessed a degree in medicine or biology and they never met.[1-3] This is reminiscent of Frederick Banting and John McLeod, the codiscoverer of insulin, who received the Nobel Prize in 1923 and who too never saw each other, either before or after, except on December 10, the day the Nobel Prize is officially conferred in Stockholm, Sweden.[1] That both of them were alien to medicine and that Hounsfield did not possess by traditional standards, any degree at all, led to a lot of hue and cry but everything gainsaid, none can ever doubt the impact of their work which led to an unprecedented advancement in the diagnosis of various ailments. He spent half of his Nobel cash award for building a laboratory in his living room, and 2 years later, he was knighted in 1981.[3]

Hounsfield is immortalized for the scale devised after his name. This is a quantitative measure of radiodensity used in evaluating CAT scans. The scale is defined in Hounsfield units, symbolized as HU, which encompasses a huge range from the density of air designated as −1000 units, running through water at 0 units up to bone, the densest human tissue, at +1000 units.[1-3]

As a person, Hounsfield was shy and retiring living in modest surroundings and had little care for the volley of honor, accolades, and encomium showered on him. He was fond of playing the piano and maintained his own time clock wherever he was in the world. Thus, he was often found, much to the curiosity of the onlookers, walking casually in the lobby of the hotel where he was staying in other parts of the world in the wee hours of the morning. He used to tell his younger colleagues, "*not to worry about passing exams so long as you have understood the subject*" and "*not to worry about not getting up before 9 am!*" He had no interest in power, position or positions, and loved most to be left alone. He treated everybody with a gesture of simplicity, was sociable and disliked the idea of being idolized as Sir Godfrey, and insisted that he should be addressed as Godfrey. A gentle, generous, and a modest man, who had all the passions to know how things worked in the world, he set his own rules, liked to work in small groups, and was hardworking by nature. It will always remain a matter of mystery as to how one with such an indifferent academic career at the school and endowed with mastery of mathematics not beyond that primary level could master the computer, invented the CT scan, and received the Nobel Prize. He used to say, "*you've got to use the absolute minimum of mathematics but have a tremendous lot of intuition*" and "*each new discovery brings with it, the seeds of other future inventions. There are many discoveries, probably just around the corner, waiting for someone to bring them to life. Could this be possibly by you?*"[3,7]

Hounsfield died in 2004. Ivan Oransky gave an excellent account of his work in an article entitled, "Sir Godfrey N. Hounsfield," published in the Lancet after his death, while Elizabeth Beckman's account, published in Physics Today in 2005, deserves serious reading, as well.[8,9]

**Financial support and sponsorship**
Nil.

**Conflicts of interest**
There are no conflicts of interest.

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