Piara Singh Gill: A pioneer cosmic ray physicist of India (1911–2002)

P. S. Gill, a pioneer cosmic ray physicist of India died on 23 March 2002 at Atlanta, USA. His life is an epic story of a man who, from a backward Punjab village rose, to be an internationally known physicist and a science-administrator. Different phases of his life, namely as a village lad in Punjab, student days in USA, cosmic ray studies in Lahore, creation of research centres at Aligarh Muslim University and Gulmarg, establishment of India's premier instrumentation facility at CSIO, Chandigarh and entrepreneurship, reflect the genius of a man who rose from the grass roots.

Piara Singh Gill was born on 28 October 1911 in a farmer's family in the Chela village, Hoshiarpur District, Punjab. Even primary education was not available in his village and he trekked 10 km daily to Kot Fatuhi to attend school. He passed his matriculation from Khalsa High School, Mahilpur in 1928 and sailed for America in 1929 to earn his livelihood. It was customary in Doaba region of Punjab that young boys left their home and hearth after high school in search of greener pastures in the UK, Canada or USA. He started working as a taxi driver in Panama. When he collected sufficient funds to pursue higher studies, he left Panama for USA in 1930. In August 1931, he joined the Sacramento Junior College as a first year student and later earned a tuition scholarship for his studies at the University of Southern California where he got his Bachelor's and Master's degrees in 1935 and 1936 respectively. For his maintenance, he picked fruits, scrubbed floors, washed dishes and did some odd jobs.

Piara Singh joined the Physics Department at the University of Chicago in October 1936 to work for his Ph D under the supervision of A. H. Compton, the Nobel Laureate. His doctorate related to the topic, 'Further studies of cosmic rays on the Pacific Ocean'. He established 'latitude effect' of cosmic rays at sea level, for which he travelled 15 times between Vancouver (Canada) and down to Hobart, Tasmania (Australia) from 28 July 1937 to 23 September 1938. Cosmic ray intensity variation with latitude was studied by means of an ionization chamber shielded by 12 cm thick lead placed onboard *S. S. Aorangi*. It was found that cosmic ray intensity shows its minimum value at the equator and then increases up to 40° latitude on both sides of the equator, with a knee at 45° latitude. Compton and his collaborators had discovered the latitude effect, but it was Gill who put it on a high pedestal through his arduous sea voyages and convincing data.

H. J. Bhabha is well-known for his theoretical work in the field of extensive air showers. An associated phenomenon of 'cosmic ray bursts' was studied by Marcel Schein and Piara Singh Gill, experimentally. In June 1939, Gill was one of the youngest delegates to attend an International Symposium on Cosmic

Rays and present a paper on the 'Size-frequency distribution of cosmic ray bursts'. This paper created great interest among the physicists, as it was the first experiment which gave clues about the spin of the pi-meson, predicted by Yukawa.

Gill was awarded doctorate in physics at the 199th Convocation of the University of Chicago in March 1940. Compton offered him a post-doc fellowship to continue his research work in USA, but Gill was keen to return and work in India. He was awarded a travelling Research Fellowship by Chicago University for a year to work in India. Compton gifted away the cosmic ray equipment built by Gill on his departure from Chicago. Gill planned to carry out experiments on the 'azimuthal variations of cosmic rays' on the basis of Vallarta's theory, as Indian latitudes and altitudes were most suitable to verify this theory.

Cosmic ray studies at various institutions

Gill sailed for India in April 1940. Customs officials in Kolkata did not clear his equipment and M. N. Saha came to his rescue. They became lifelong friends after this first meeting. In August 1940, Gill joined Forman Christian College, Lahore, as a lecturer in physics. He set up his research laboratory to perform experiments on azimuthal effect of cosmic ray intensity. Gill was teaching physics to B Sc students in F.C. College and to M Sc students in Punjab University, Lahore. In the summer of 1945, with a meagre grant of Rs 300, he organized an expedition to the Himalaya to carry out an experiment on the production of mesons by non-ionizing component of cosmic rays. The expedition went up to Baralacha Pass at a height of 17,000 ft without any oxygen masks, but the results were negative showing no production of mesons. Later on, these experiments were repeated at Lahore using Royal Air Force 'Mosquito' plane to fly up to heights of 33,000 ft, and meson production was detected beyond 20,000 ft. Vallarta was happy to know the results and he reported in the *Physical Review* about the importance of Gill's experiments. During 1946, Gill visited USA and Europe and delivered invited lectures on the cosmic ray experiments carried out in India. He met his old collaborators in Chicago and Professors Victor Hess, P. M. S. Blackett and P. Auger in Europe.

H. J. Bhabha was impressed by the experimental research work carried out by Gill at Lahore; he offered him Professorship in Experimental Physics at the Tata Institute of Fundamental Research (TIFR) Mumbai in July 1947. Gill embarked upon a series of experiments which consisted of sending apparatus to high altitudes with the aid of hydrogen-filled balloons and recorded the data transmitted by the sensor on to a tape on the ground. Mrs Chambeli Gill, in her memoirs, refers to the popularity and publicity gained by Gill in the elite Mumbai society due to these balloon

flights from Santa Cruz, that it caused some heartburning and jealousy in the mind of Bhabha. To avoid the collision course with India's most eminent physicist, Gill left for USA in April 1948 and resigned from TIFR in July 1948. He worked in Carnegie Institute of Washington and studied the relationship between solar flares and sudden increases in the intensity of cosmic rays, in collaboration with M. S. Vallarta and S. E. Forbush.

Gill had personal friendship with Pandit Nehru, India's first Prime Minister, who knew about his experiments in Lahore. He was appointed Officer-on-Special Duty (OSD) with the Atomic Energy Commission in New Delhi, after his return from USA. He got an invitation to work at the National Bureau of Standards (NBS) and to assist the Indian Embassy in Washington DC as a Scientific Advisor. He was instrumental in setting up the Neutron Standardization Laboratory at NBS. Zakir Hussain, the then Vice-Chancellor of Aligarh Muslim University prevailed upon Nehru to relieve Gill as OSD and offered him Professorship at Aligarh. On his return from USA, Gill accepted the offer and joined as Professor & Head in the Department of Physics at Aligarh on 1 September 1949.

The most fruitful phase of Gill's life was at Aligarh Muslim University where he spent 14 years (September 1949–September 1963). The department of physics needed complete rejuvenation after partition of India, as most of its faculty had migrated to Pakistan. Gill took immediate steps to bring the syllabi of M Sc up-to-date to improve teaching of physics, set up well-equipped research laboratories in the fields of Cosmic Rays, Nuclear Physics, Microwave Spectroscopy and Theoretical Physics. By the end of the fifties, Aligarh Muslim University became a leading centre for research, vying with Universities at Kolkata, Allahabad and Banaras. The High Altitude Laboratory was set-up at Gulmarg in 1951 as a joint venture of Aligarh Muslim University and Kashmir University, Srinagar. Later on, the Department of Atomic Energy also set-up its own version of the High Altitude Laboratory in Gulmarg to justify Bhabha's old rivalry in cosmic ray studies. Several students of Gill worked at Gulmarg, using Geiger Muller counters and nuclear emulsions prepared at Aligarh, to study the 'time variations of cosmic rays and extensive air showers' at high altitudes. A. H. Compton in his report to S. S. Bhatnagar, the then UGC Chairman, commented upon the work of Gill, Director, Gulmarg Observatory, and wrote: 'The chief factor that is essential to the successful operation of the Gulmarg Observatory is its Director. It is difficult anywhere to find the combination of scientific competence, originality of ideas, persistent drive, executive responsibility and personal tact that is essential in such a Director. Gill has these traits to an unusual degree'.

Role as an institution builder in India

Central Scientific Instruments Organization (CSIO) was established under the CSIR in 1959, with the object of production, design, service and repair of scientific instruments and training of technicians. Gill set out to give these objectives a practical shape soon after he joined CSIO as its Director in September 1963. CSIO got shifted from New Delhi to Chandigarh, the then capital of Punjab. The changeover from an experimental physicist to an instrument designer may seem to be a little awkward, but Gill had the vision to undertake such a gigantic task. A team of devoted young scientists was picked up, trained abroad and the development of new instruments in the fields of Optics, Electronics, Medical Sciences, Geosciences, Environmental Sciences and Process Control Technology started in India. An Indo-Swiss Training Centre was set-up to train instrument mechanics of the highest calibre. CSIO established itself as a leader in instrument design in Asia.

After his retirement in 1971 as Director CSIO, Gill joined Punjab Agricultural University, Ludhiana as Professor Emeritus. He wrote textbooks in physics for higher secondary school students in English which I translated into Punjabi. These were published by the Punjab School Education Board, Mohali. A monograph 'Atom and its Nucleus' written by Gill was translated into Punjabi and published by Punjab State University Text-Book Board, Chandigarh. Gill had an eventful career with many ups and downs in his life. His autobiography, *Up Against Odds*, reads like a novel and gives a vivid account of many episodes of his life in India and abroad.

Gill had a long innings and changed many professions. From an instrument designer, he became an entrepreneur and set-up his manufacturing unit near Chandigarh. Magnetic heads were made in this unit for tape recorders. Ultimately, he sold this unit and migrated to USA to spend the rest of life with his daughter, Suristha G. Sehgal, Professor of Psychology at Georgia State University, Atlanta where he breathed his last on 23 March 2002.

Gill always inspired his co-workers and students. He was punctual and never missed his theory classes, despite heavy engagements. His students occupied eminent positions in the universities and scientific establishments of the country. During the seventies, almost all Heads of Physics Departments in north India, from Kashmir to Kalyani University in West Bengal, were old students of P. S. Gill. He was a teacher of teachers and an institution builder in modern India. May his soul rest in peace!

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