IN MEMORIAM

Indra Bir Singh
08/07/1943 – 11/02/2021

[Life Span: 08.07.1943 – 11.02.2021 at Lucknow; Parents: Shri Chaudhri Atar Singh and Smt. Ram Kumari; Schooling: Mansa Din Shukla College, Jubilee Inter College, Lucknow Christian College; Higher Education: B.Sc. Hons, M.Sc. in Geology University of Lucknow (1962), Dr.er Nat Technical University of Stuttgart, Germany (1966), Post-Doc: University of Oslo].

An outstanding Geologist and an author

Indra Bir Singh was one of the few outstanding sedimentologists all over the world. He continued to remain involved in developing actualist sedimentation models through studies in the present depositional environments. He successfully used them in making palaeoenvironmental interpretations of many rock sequences in India, Europe, and the United States. His studies on the modern coastal sediments of the North Sea in a team led by Prof. Dr. H. E. Reineck at Wilhelmshaven, Germany, led to the development of facies models for tidal channels, sandy coastal shoals, and beach-shelf regions. These studies lead to understanding the genesis of laminations in such deposits. All over the world, workers still follow these inferences and ideas, especially those engaged in the sedimentological research on the continental shelf. A series of papers on these aspects were published in German language journals, culminating in a collaborative book, "*Depositional Sedimentary Environment*" published in 1973 by Springer-Verlag. This book serves as a permanent resource book by the sedimentologist working with sand deposits, especially the petroleum geologists. The Second Revised and Enlarged Edition were published in 1980 and later translated into Russian and Chinese languages.

He wrote another important book, *"Delta Sedimentation: East Coast of India"* co-authored by Dr. A. S. R. Swamy of Andhra University. This book still serves as a reference book for oil exploration companies. Indra Bir was an active member in several UNESCO-International Geological Correlation Program projects (renamed Geoscience program) and served as Convener of Project 219. He served on the Advisory Board of the Directorate General of Hydrocarbons (DGH), remained registered as the U.N. Expert in Aquatic Sciences of FAO at Rome since 1968, and enjoyed the credit of organizing the first SERC (DST) School on Coastal Sedimentation.

Foray in the Geology of India

Indra Bir was involved with many sedimentological studies related to the Indian stratigraphy. His studies included clay mineralogy, heavy minerals, and petrography of the Lower Gondwana sediments of the Korba Coalfield that indicated climatic control on the mineralogy. His facies interpretation of the Vindhyan sediments demonstrated that the coastal alluvial plain merged with tidal flats due to the absence of vegetation during the Precambrian. He also explained why tidal flats facies are more dominant during sedimentation in the Precambrian sea.

The Unorthodox Rebel

In 1996, Indra Bir proposed an unorthodox age and facies model of the Lesser Himalayan formations, which boldly contradicted the century-old age connotations of this massive rock pile. He refuted the correlation of the Blaini sedimentary unit with the Talchir sediment in Peninsular India. Instead, he proposed that the Krol belt represents deposits of a shallow tidal sea and is Late Precambrian in age with overlying Tal Formation extending into Lower Cambrian. Changing the age of the Krol-Tal succession from Mesozoic to Precambrian-Early Cambrian had far-reaching consequences in interpreting the pre-collision history of Himalaya. He proposed three distinct marine transgressions of Early Permian, Late Cretaceous, and Early Eocene in Lesser Himalaya, represented by patchy, small outcrops of these ages as windows/ outliers. In collaboration with his students, Vibhuti Rai, he identified numerous trace fossils of Lower Cambrian affinity in the Tal Formation. Working with Prof. Dr. Manfred Schidlowski and Prof. Paul Aharon, he carried out a pioneering study on carbon and oxygen isotopes excursions to define the Pc-C Boundary in the Mussoorie Hills. Indra Bir's contribution to our understanding of the depositional environment of the Shimla and Dagshai-Kasauli rock successions remains noteworthy.

Outstanding contributions

His other invaluable contributions include the re-interpretation of the Karewa conglomerate deposits in terms of dynamic stratigraphy using a non-glacial lake-basin model in contrast to the ideas advocated by earlier workers. His new depositional model for the Bhuj Formation in Kachchh (Kutch), Gujarat, lead to significant revisions in the palaeogeographic reconstructions of the western Indian sedimentary basins. In contrast to the general belief, the Bhuj Sandstone was interpreted as a shallow marine deposit and not fluvial. Similar pioneering studies led to a new understanding of the evolution of the Tethyan sedimentary succession. He explained the uniqueness of the late Precambrian sedimentation and palaeogeography of the several Indian cratons. His facies models prepared for the Vindhyan sedimentary succession have stood the test of time. However, his sedimentation model for the Lameta sediments drew criticism.

He used to say that first, he would like to acquaint himself with Indo-Gangetic plains before tackling the Siwalik. True to his conviction, he initiated for the first time the sedimentological and geomorphological studies in the Gangetic Plains focusing on point bars and levee deposits. Studies in the Gangetic Plain provided insight into the Gomti and Ganga River sediments. They revolutionized the fundamental concept involved in understanding the evolution of the fluvial-dominated foreland basin. It was demonstrated that active lineaments controlled the position of NW-SE and W-E flowing rivers. In collaboration with his colleague Surendra Kumar, this work on the Ganga Plains remains the most comprehensive study of a plain alluvial river. His studies demonstrated the role of Late Quaternary climate changes in the evolution of various geomorphic features. He also made significant archaeological discoveries in the Ganga Plains with a seminal conclusion.

The Formative Years

Some of his school/college mates who grew up with him and successfully chartered their lives included Nirankar Prasad, Sayyed Abbas Jafar, Satya Prakash Rastogi, Ravi Shanker, Avinash Chandra, and Surendra Kumar. His undergraduate colleagues who maintained links, including till end, were well-known U.S.-based Oncologists (Manatosh Banerjee), the top Orthopedic Surgeon of India (D.K. Taneja).

Immediately after the M.Sc. results were declared, Indra Bir got the job of Senior Technical Assistant in the Oil and Natural Gas Commission. Due to the temporary discontinuation of GSI recruitments, getting the STA appointment was considered quite prestigious. He worked in the office of the erstwhile Director Dr. B.G. Deshpande compiling data sets received from the exploratory oil wells in Gujarat. As a colleague, he had some of the bright Lucknow University alumni, viz. Aditya Chaubey, Laxman Singh, Bindesh Srivastava, and Avinash Chandra. Bored with routine file work, in 1963, Indra Bir left for Germany to write a thesis for a Doctoral degree.

Very few people knew that Indra Bir's Doctoral degree from the Technical University of Stuttgart in 1966 was based on a thesis (published as a Monograph in the German language) on Triassic-Jurassic boundary beds. He established a distinct time-break in an apparently conformable-looking sequence and recorded geochemical changes caused by transgression in the underlying sediments. His Doctoral Supervisor was Prof. Dr. H. Aldinger and his thesis was published in the form of a Monograph in 1966. He wrote two chapters on Scour Marks and Tool Marks for the prestigious Encyclopedia of Earth Sciences. During his Post-Doc assignment in the laboratories of Prof Barth in Oslo, Norway, he carried out a pioneering study on the quartzites of the Telemark region in Norway. There he established similarities of these rocks to present-day tidal flats. For the first time, stretched boudin-like pebbly beds in this succession were interpreted as modified lenticular-flaser beds.

While Indra Bir was spending time in Oslo as PDF, Prof. Dr. H. E. Reineck, an expert in tidal flat sedimentation, invited him to join his research group as *Mitarbieter* (co-worker) in the Seckenberg Oceanographic Institute at Wilhelmshaven in north Germany. Indra Bir and his Institute associates spent weeks and months on the cold, windy seashores at such high latitude, prepared the core, and studied the dynamics of different sedimentary structures in situ. He recorded how the sand grains roll over the beach, leaving behind a specific shape that gets destroyed or modified in diurnal cycles over weeks and months. These studies provided great insight into the tidal processes, which could be correlated to structures found in the ancient rock records. Through these extensive studies, he propounded simple as well as complex sedimentation models. Once, he told me, "*it was amusing and educative to see the sand grains dancing to the tune of the tidal waves and modify their behavior with changing hydrological and micro-morpho-tectonic domains*." He translated his experience working on the sand of modern tidal flats to interpret old consolidated rock records of all ages. His authoritative "judgmental" interpretations in a scenario where controversies exist created numerous enemies and detractors, and all of them had to realign in due course. They had to fall in line with his interpretations. However, his command of the modern Quaternary to the ancient Precambrian sedimentary successions remained unchallenged. Indra Bir remained the last word in accurately defining the shallow marine facies and created great academic storms in the National and International fora.

Professional Life

On returning to India in 1972, he joined the Scientific Pool of CSIR and then served Lucknow University as Lecturer, Reader, and Professor till his retirement in 2006. He hardly enjoyed his term as the Head of the Department between 1995 and 2003, which he felt was at the cost of his academic pursuits. He was an Alexander von Humboldt Fellow in different German Universities from 1978-to 79 and spent the time between 1984-1986 as Visiting Associate Professor at the Louisiana State University, Baton Rouge, USA. Between 1998 -1999 DAAD-DFG program gave him a time-bound appointment as a teaching Professor at the University of Erlangen-Nuremberg, Germany.

Recognitions

Recognition came to Indra Bir in the form of election to the Fellowship of the Indian National Science Academy in 1995, L. Rama Rao Birth Centenary Award of the Geological Society of India in 1996, Life Time Achievement Geoscience

Award by the Ministry of Mines, Government of India in 2014, and Special Commendation from the Governor of U.P. for his contributions to the academic and corporate life of the Lucknow University at the time of Centenary Celebration of Lucknow University. He also served as INSA Senior Scientist and INSA Honorary Scientist.

Post Retirement

There was no change in the academic pursuits of Indra Bir even after his retirement in 2006. He did not show any mental fatigue due to his official retirement and went on publishing memorable research papers and engaging in sedimentology classes without any remuneration.

Last year, I wrote in some text that *"he acquired an iconic image of an individualist and a bold thinker with an intuitive mind."* Alone, he could outright reject several age-old concepts, most religiously promoted in the geological literature of this country. Most prominent among these are outright discarding of the Palaeozoic and Mesozoic ages of outer Lesser Himalayan sedimentary succession and the establishment of the Precambrian age of these rocks. Indra Bir contributed to the entire spectrum of Indian stratigraphy from oldest to most recent strata.

Personal Traits

Indra Bir was overtly casual in dressing even for the official functions. Faded, partly torn Levis jeans completed his full attire. Although he could not sing a single line, he enjoyed good classical music. He loved eating sweets and good food, more so in his younger days. He had a pleasant demeanor, except for those who would talk geological nonsense. He was always harsh on them. He had a very sharp mind, saturated with novel ideas. As a teacher, he influenced a generation of students who, on their own, are successful in their profession. He remained a happy person watching the progress made by the students trained by him. These include Uma Kant Shukla, Dhruv Sen Singh, and Pradeep Srivastava. Some of his students are carrying on his legacy with confidence.

Above all, he was a great humanitarian and an excellent, compassionate friend.

Good Bye Indra Bir

Some unforeseen illness struck him hard in the last three years and took him away from all of us. The sad demise of Professor Dr. Indra Bir Singh in the early hours of 11th February 2021 stunned the entire geological community in India and abroad. Indra Bir was proud of his alma mater Lucknow University, which provided him the platform to contribute to various aspects of Earth Sciences. With his death, the world has lost an internationally well-recognized geologist with broad interests in Earth Sciences. He left behind a mourning wife, Janak, and two sons, Shwetabh and Arunabh.

Indra Bir Singh will remain irreplaceable in the Indian geological domain for a long time.

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