



Professor Arun Kumar Biswas
(July 6, 1934 – November 30, 2015)

Professor Arun Kumar Biswas: A Biographical Sketch

Arun Kumar Biswasⁱ was born on the 6th of July, 1934 in Calcutta. After his initial studies at Saint Xaviers College (1948-52), he went on to Science College (1952-59) (both in Calcutta) to complete his Master and Doctorate degrees in Applied Chemistry. He submitted his doctoral thesis (1959) on surface-active agents from glycerides and their fascinating micellar world in aqueous solutions. Inspired by the advice of his mentor, Dr. K.K. Majumdar (who later became the founding President of the Indian Institute of Mineral Engineers (IIME)), Prof. Biswas took up mineral engineering as one of the goals of his professional career and the study of the challenging subject of froth flotation which involved the investigations related to surface science, one of his passions. In his own words, ‘... Biswas contacted Professor AM Gaudin of MIT and was warmly invited ... and then opened before him the glamorous world of MIT education in several fields: mineralogy and crystallography (William Dennen and Martin Burger), optical mineralogy (GE Agar), mineral engineering (AM Gaudin), physical chemistry of surfaces (PL de Bruyn and Alan Michaels) and even archaeometallurgy (the famous CS Smith) and history of science and civilization (guess who, Aldous Huxley who was a Visiting Professor during the Centenary year of 1961)!’ He went to MIT as a Fulbright Fellow. At MIT (1960-63), he worked on hysteresis of contact angle under the guidance of Professor Antoine Marc Gaudin. Learning at MIT was not confined to science of mineral processing; he continued with his interest in music, which he developed in early fifties, and simultaneously attended a course in Music Department on ‘Music Appreciation’. Coincidentally, this was also the time when Indian Institute of Kanpur (IIT/K) was being established with the help from the Kanpur Indo-American Programme (KIAP) and under the leadership of Professor P K Kelkar as its founding director. Prof. Norman Dahl of MIT was the leader of KIAP and Prof. Gerhard Derge, the eminent extractive metallurgist of the Carnegie Institute of Technology (later Carnegie-Mellon University) and the then editor of the Transactions of AIME, was in-charge of

developing the Metallurgy Department at IITK. Professor Derge invited Dr. Biswas to visit Pittsburgh and later to join him at IIT/K and develop the mineral engineering programme. He returned to India and joined as an Assistant Professor in the Department of Metallurgical Engineering (now Materials and Metallurgical Engineering) at IIT/K in 1963. Thus began his 32 years long distinguished career (1963-95) at IIT Kanpur where he became Associate Professor and Professor in 1968 and 1971, respectively. He married Sulekha in 1964, and their only child, Sandipan was born in 1973.

The essence of his early years at IIT Kanpur can be gauged from his personal recollection, ‘During the period 1964-1970, Biswas was extremely busy in organising the mineral engineering programme at IIT Kanpur in collaboration with his esteemed colleagues: TC Rao who had worked with Professor AJ Lynch in Australia, A Ghosh who had worked with Professor TB King at MIT, and the two geologist colleagues: KVGK Gokhale who wrote a book on mineral resources in India, co-authored by TC Rao, and BC Ray Mahasay the renowned geochemist from the Harvard University. Professor Gerhard Derge had gone back to USA, but he kept on sending valuable advice to Biswas on the subject of mineral engineering ... 1968 ... , A K Biswas planned a Short Course on ‘Mineral Engineering Practice’ to be held at IIT Kanpur on 27 and 28 February 1969, to be followed by a Seminar on ‘Mineral Engineering Education’ scheduled on 01 March ... An invitation was sent to Professor AM Gaudin through the KIAP (unfortunately the visit did not take place) Professor Gaudin’s love for antiquity was very deep and infectious, imbibed by many of his students, including AK Biswas’. In 1969, he published his first book, ‘Science in India’ (Firma KLM, Kolkata). Along with Dr. KK Majumdar, head of ore dressing section at BARC and several other stalwarts working in the area of mineral processing, he played a very active role in the setting up of Indian Institute of Mineral Engineers (IIME)ⁱⁱ which was registered as a Society on 12 November 1969. On his association with IIME, in 2012, he observed, ‘I was proud (and still am) to become the first Life Member (LM 1) of the proposed institute’.

During his distinguished career of 32 years (1963-94) at IIT/K, Prof. Biswas developed and taught several courses related to mineral processing. He established the Materials Separation and Surface Chemistry laboratories. Prof. Biswas enjoyed the reputation of a dedicated teacher and was popular among students. Industrial perspective was a hallmark of his teaching. Starting from his early carrier, he used to visit mineral based industry/institutes almost every summer. Besides teaching, he guided many students in their research at Doctoral, Masters and Bachelors levels. Many of them are well-established professionals now in India and abroad.

Prof. Biswas believed that both basic and applied research are critical for the industry. He advocated the importance of characterisation in mineral research and collaborated with several of his colleagues in the Institute, notably Professors TR Ramachandran and Ranjit K Ray. The motivation of many of the research projects pursued under his guidance was to find innovative means of beneficiating several complex and/or low-grade Indian mineral deposits, such as monazite beach sand, zircon, molybdenite, diamond, phosphorites, zinc ferrite, zinc tailings and residues, alumina-rich iron ore, pyrite, separation amongst calcium mineral systems, Kudremukh-iron ore tailing, deep sea manganese nodules, ferrotungsten deposits etc. Simultaneous studies were also carried out in his laboratory on several key unit operations in mineral processing, such as comminution, froth flotation, selective flocculation, leaching and bacterial leachingⁱⁱⁱ. In basic research, some studies by Biswas and his coworkers received international attention; for example:

- role of CO₂ in calcite flotation
- collector-frother interactions
- adsorption at three phase interline
- tannin-fatty acids and starch-fatty acids interactions in calcite-fluorite flotation separation
- selective dispersion and flocculation in hematite-clay system

In late seventies and eighties, Biswas and coworkers made important contributions towards characterization of mineral separation systems using XRD, SEM with X-ray microanalysis, EPMA, TEM and several spectroscopic techniques (IR, NMR, Mossbauer, etc). The systems studied included fine grained alumina-rich Indian iron ore, Zn-containing flotation tails, Zawar ancient siliceous slag and retorts, and ferromanganese nodules from the Indian Ocean and their synthetic analogues, chalcopyrite, and synthetic tungsten minerals. Prof. Biswas participated in several important international conferences such as International Mineral Processing Congresses (Cannes, 1963; Prague, 1970; Cagliari, 1975; Warsaw, 1979) and International Symposium on Surfactants, Gainesville, Florida, 1990.

Intellectual activities of Prof. Biswas extended far beyond mineral engineering and covered languages, archaeometallurgy, minerals and gems in ancient India, literature, music and religions - mostly in the Indian context. Prof. Biswas was the Founder-President of the Indian Languages Society which organized a national seminar on Profiles in Indian languages during December 10-12, 1982. The proceedings of the seminar were published as a multi-authored book 'Profiles in Indian

languages and literatures' which received international acclaim. The period around 1980 was also the beginning of his increasing interest in archaeometallurgy. Characterisation studies on ancient slag and retorts from Zawar mines later culminated in a number of papers on the primacy of India in brass and zinc metallurgy. During 1987-90, History of Science Division of Indian National Science Academy (INSA) sponsored a project on 'Minerals and Metals in Ancient India up to 1200 AD from Sanskrit Literature and other Sources'. In this project, he was ably assisted by his wife, Sulekha, a Sanskrit scholar. The project completion report submitted in 1991 later (in 1996) resulted in the publication of the monumental monograph called 'Minerals and Metals in Ancient India'. This two volume monograph (volume 1 – Archaeological Evidence, Volume – 2 Literary Evidence) tells the fascinating, coherently woven story of the Mineral and Metals from across the entire sub-continental sprawl of the old-world India (including Pakistan and Bangladesh). In following years (1991-94), INSA sponsored another project on Minerals and Metals in Pre-Modern period (1200-1900 AD) which led to the publication of several interesting papers in Indian J History of Science; Gem minerals in pre-Modern India [29(3) (1994) 389-420], Non-Gem Minerals in Pre-modern India [29(3) (1994) 421-463] and Iron and Steel in Pre-modern India [29(4) (1994) 579-610]. Prof. Biswas delved deep into the ancient Indian texts and established the etymology of beryllium-containing minerals in the Indian and world literature - particularly of Beryl (Vaidurya) and emerald (Marakata) [Ind. J History Sci, 6 (1994) 13-28]. During the period 1985-94, he also wrote and edited several books: Swami Vivekananda and the Indian Quest for Socialism (Firma KLM Pvt Ltd, Calcutta, 1986); A Pilgrimage to Khetri and the Sarasvati Valley (Sujan Publications, Calcutta, 1987); Buddha and Bodhisattva - A Hindu View (Cosmo Publications, New Delhi, 1987); Frontiers in Applied Chemistry (edited volume, Springer Verlag, Berlin and Narosa Publishing House, New Delhi, 1989); and Swami Vijnanananda and his Paramahansa Carita (Sujan Publication, 1994).

The superannuation of Professor Biswas from IIT/K on July 31, 1994, marked the beginning of a new chapter in his life. He moved to Kolkata where he spent a lot more time with Ramakrishna Mission. He served several organizations in various honorary capacities for example, Mahendralal Sircar Research Professor in History of Science at the Asiatic Society, Kolkata (1995-2001); the AICTE Emeritus Fellow at the Jadavpur University (2001-2004); and INSA Research Fellow in Kolkata. He joined as a member of the INSA National Commission for History of Science and the editorial board member of the Indian Journal of the History of Science.

Prof. Biswas' academic interest and firm conviction that both social sciences and humanities and science and technology are essential for human progress, propelled him to publish a large number of research papers and reviews on a wide spectrum of topics^{iv}. The topics covered included: Epic of Saltpetre to Gunpowder; Why did Scientific Renaissance take place in Europe and not in India; Raman, Krishnan and the IACS Episodes of the 1930's; The Era of Science Enthusiasts in Bengal (1841-1891); Akshayakumar's; Vidyasagar and Rajendralala; Calcuttan Science 1784-1930 and the Awakening in India; Rammohun Roy, his Intellectual Compatriots and their

Scientific Contributions; Syncretism in the Future of Humankind – Some Golden thoughts of Swami Vivekananda; Social Factors in the Development of Technology in Ancient India; Science, Spirituality and Socialism: A Tribute to Joseph Needham; Science and Music with a Special Note on Helmholtz, James Jeans to Pandit Ravishankar. He also published some interesting book reviews, such as: Images and Contexts: The Historiography of Science and Modernity in India; Story of the Delhi Iron Pillar; Jagadish Chandra Bose and National Science; Kautilya's Arthashastra in the light of modern science and technology; An Eye For Excellence: (Fifty Innovative Years of IIT Kanpur); la vintage metallurgie (coffee table book, CSIR-NML); Caught between two Cultures – Science in Nineteenth Century Bengal, etc. Some of his well-known books after 1995 include:

- Gleanings of the past and the science movement : in the diaries of Drs. Mahendralal and Amritalal Sircar (The Asiatic Society, 2000);
- History, Science and Society in the Indian context (The Asiatic Society, 2001);
- Minerals and Metals in the Pre-Modern India (DK Printworld, 2001);
- Father Lafont of St. Xavier's College, Kolkata and the Contemporary Science Movement (The Asiatic Society, 2001);
- Collected Works of Mahendralal, Father Lafont and the Science Movement (The Asiatic Society, 2003);
- Science in Archaeology and Archaeo-materials (DK Printworld, 2005);
- Mineral Processing to Elemental Science in the Medieval World: India and Europe (The Asiatic Society, 2011);
- Mineral Engineering in India – Reflections (IIME, 2012); etc.

Prof. Biswas writings were not confined to English language alone. He also wrote several books and articles in Bengali and the topics encompassed spirituality, art and science to short stories; for example:

- Śrīśrī Rāmakṣhṇa janmoṭasaba o abatāra - pūjāraādīparba (Kalakātā :Phārmā Ke . Ela. Ema, 2003).
- Aśārīrī (Dhākā : Dibyaprakāśa, 2007)
- Raktakheko hīrera putula (Dhākā : Jāgrti Prakāśanī, 2011)
- Mātri Sādhanā O Kamālākānta (Ananda Publishers Private Ltd. and Signet Press, Kolkata, 2013)
- Rgveda Theke Rta Sri Ramakrishna (Sanskrita Pustak Bhandar, Kolkata, 2008)

In spite of his varied interest, Prof. Biswas remained committed to the profession of mineral engineering all through his life. At the request of Dr. Pradip, President of XXVI International Mineral Processing Congress (IMPC September 24 to 28, 2012, New Delhi), Professor Biswas agreed to publish his work on, 'Mineral Engineering in India – Reflections' on the occasion of the Congress and for the benefit of all the delegates participating in the Delhi IMPC. In his own words, 'I hope this critical review of our past achievements in the field of mineral engineering and my personal reflections on the strategies for the future will be of general interest to the mineral

engineers not only in India but to all professionals associated with this field in other countries as well'. In the book, he also highlighted his unfulfilled dream of the setting up of a National Mineral Engineering Research and Training Institute (NMERTI) – an institute devoted to pursuit of excellence in mineral engineering, an area of immense importance to India.

We would like to conclude this biographical sketch with a quote by Mendelssohn which Prof. Biswas referred in his paper, 'Science and Music with a Special Note on Helmholtz, James Jeans to Pandit Ravishankar (Sci. Cult., 79(7-8), 294-301) – 'Emotional content of music cannot be translated into words, not because music is vague and more indefinite, but because it is so exact that it cannot be defined by anything, so ambiguous as language'. Just the way it is difficult to give shape to music through language, same is the case with the persona of Prof. Biswas. Professor Biswas was a great teacher, an accomplished scholar, a prolific writer and a sincere mentor. Professor Biswas has left behind a rich legacy in the form of his own writings which will continue to inspire many of us professionals and a whole generation of accomplished professionals who will continue to take his legacy of scholarship forward. Professor Biswas had his own code of conduct and values. He has left indelible impressions on whosoever came in contact with him. Lastly, this biographical sketch will not be complete without recognizing the invaluable role Mrs. Sulekha Biswas has played in the life of Professor Biswas and contributed to his multi-faceted accomplishments.

ⁱ Some of the quotes and details are taken from Mineral Engineering in India – Reflections (AK Biswas, IIME, 2012); and tributes offered in the special session organized during MPT-2016 (Pune, India)

ⁱⁱ Information on the founding of IIME and its First Executive Council is available on the link www.iimeindia.com/newlook/about.asp

ⁱⁱⁱ select research publications in different areas (including those before MIT era): *Surface Chemistry (general)* J Phy Chem 64(1) (1960) 1-4, Journal of the American Oil Chemists Society 37(4) (1960) 171-175, Nature 200(4912) (1963) 1203; *Surface Chemistry (mineral processing)* Trans SME (March 1964) 1-5, Nature 217(5135) (1968) 1255, J Colloid Interf Sci 64(2) (1978) 214-227, Kolloid Zeitschrift & Zeitschrift Für Polymere 254(5) (1978) 522-529, Intl J Miner Process 11(4) (1983) 285-302, Flotation Colloids and Surfaces 9(3) (1984) 219-235; *Characterisation* Trans Indian Inst Metals 37(3) (1984) 234-241, Physica Status Solidi A 87(1) (1985) 267-271, Trans Indian Inst Metals 44(2) 119-130, 45(5) 287-301, 47(5) 273-285; *Leaching/bio-leaching* Hydrometallurgy, 2(2) (1976), 171-184, Hydrometallurgy, 15(3) (1986), 267-280, Hydrometallurgy, 25(1) (1990), 61-83, J. Gen. Appl. Microbiol. 37(1) (1991), 1-8., Hydrometallurgy, 32(1) (1993), 39-59, Hydrometallurgy, 44(1-2) (1997), 65-69

^{iv} Some key references can be found on the links <http://worldcat.org/identities/lccn-n85103682/> <http://insa.nic.in/UI/Searchlisting.aspx?kwd=Arun%20Kumar%20Biswas>