Sheela Kusumgar (1939–2020)

Sheela Kusumgar of the Physical Research Laboratory, Ahmedabad, breathed her last on 10 June 2020. She contributed extensively to the methodology and applications of radiocarbon dating to the Indian archaeology. To date, most of the chronology of archaeology sites in India largely derives from her painstaking efforts spanning four decades from 1961 till 1999 and in this effort D. P. Agrawal provided her radiocarbon ages, an interface with Archaeological sciences.

During the early sixties, Devendra Lal, at the behest of Homi Bhabha (then Director, Tata Institute of Fundamental Research), set up a laboratory for radiocarbon dating in India. Radiocarbon dating was proposed by Willard Libby around 1950, and the method quickly gained traction and Libby received the Nobel Prize for this work in 1960. Lal established this method in India and Kusumgar assisted him in every aspect of this effort and this laboratory was functional in India in 1961. TIFR laboratory was amongst the first few globally. Sometime soon thereafter, Agrawal joined the group to provide an interface with Archaeological sciences. This complementarity of expertise in the laboratory measurements and field aspects worked wonders for Indian archaeology.

Kusumgar's scientific journey started after her graduation in Chemistry, from Mumbai University in 1960. She began as a teacher in science and mathematics at the R. C. Jain High School, Bombay. After a year, in 1961, she joined TIFR as a scientific assistant in the experimental division and began her work with Lal. Thereafter her association with radiocarbon continued uninterrupted from 1961 till her superannuation in 1999, as a Scientist-SF.

The radiocarbon laboratory served as a National facility for the Indian archaeology and later for geology as well, when palaeoclimate studies also needed radiocarbon ages. In this effort, she worked closely with Agrawal, who developed the requisite field/archaeology interface. The radiocarbon laboratory at TIFR moved to the Physical Research Laboratory (PRL) in 1973 and Kusumgar also joined PRL. Under her tenure, around 1500 radiocarbon dates for different archaeological sites in India were measured and the Kusumgar–Agrawal team provided a sound basis for the chronology of most of Indian archaeological sites. The ages provided by her stand robust even after several decades. Besides, the firmament of chronological framework for Indian archaeology, Agrawal–Kusumgar provided new archaeological insights that were based on secured radiocarbon ages and these included demonstration of the contemporaneity of Southern Neolithic, Chalcolithic and Harappan cultures, suggesting the absence of unilineal societal evolution in India. Their book, *Prehistoric Chronology and Radiocarbon Dating in India*, published in 1974, was a benchmark contribution to Indian archaeology.

At PRL, she carried out the development of new methodologies for improving sensitivity and analytical qualities of radiocarbon measurements. The most notable was the move from gas phase counting using Oeschger double chamber gas counters to liquid scintillation counting. These reduced the counting time, improved on the background and facilitated larger turn over. Kusumgar successfully implemented this changeover. She was universally respected for her exceptional experimental acumen and as a meticulous worker. This was seen by the fact that the radiocarbon laboratories at TIFR and PRL, under her, accredited itself well in all the international intercomparisons it participated in. And, this tradition continues till date.

Kusmugar obtained her Master's degree (Physics) in 1966 from the Bombay University and her PhD on 'Geochronology of the palaeoclimate events of the Late Cenozoic events in the Kashmir valley'. Both the theses were supervised by Devendra Lal, an internationally acclaimed name for his fundamental contributions to cosmic ray produced isotopes in rocks, liquids and gases. For her doctoral thesis, besides radiocarbon dating, Kusumgar developed the palaeomagnetic stratigraphy of Karewa Sediments in Kashmir and used fission track ages on embedded volcanic ashes to reconfirm that their chronology extended to a few million years. In the process, she setup a laboratory for measurement of palaeomagnetic polarity of sediments at PRL.

During her career, Kusumgar spent extended periods at the radiocarbon dating laboratories at Groningen University (Netherlands), Oxford University (UK) and Cambridge Universities (UK) and worked on learning/evolving new techniques in radiocarbon. She had an excellent ability to develop very sensitive low volume gas proportional counters with efficient suppression of cosmic ray produced background. In the nineties, she played an important role in developing the Accelerator Mass Spectrometry (AMS) technique for radiocarbon measurements in India. She developed precision radiochemical lines, required to convert sample carbon into graphite, for use as a target for a radiocarbon assay using a pelletron. This was done for the first time in India as an indigenous effort led by her. Kusumgar also helped with the establishment of radiocarbon laboratory at the Birbal Sahni Institute of Palaeobotany (now Palaeosciences).

Kusumgar was a quiet, serious, meticulous and a self-motivated worker, whose fundamental contributions to Indian archaeology were sadly, never really recognized fully and formally.

Her colleagues will remember her as a caring, helpful, affectionate colleague, as a devoted and a skilled worker and a person with special concern for the younger colleagues. We deeply mourn the loss of this silent, dedicated unsung colleague, who made a fundamental and lasting difference to Indian archaeology.

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