It was hard to take what the computer screen was showing. Amalabu was no more, on that fateful Saturday afternoon. It was more so for me because I had returned from Kolkata that morning and had seen him on the previous Monday. I am referring to Amal Kumar Raychaudhuri, whom we all fondly call AKR and revere with great awe and affection, passed away on 18 June 2005. When I met him four days before his demise, Raychaudhuri told me not to discuss any physics for he had made trivial mistakes in calculations that he could no longer trust himself. This innocent statement now makes me reflect whether he felt that his innings was over, and that there was no reason to go on if he could not do physics in the manner he would have liked to do!

Inter-University Centre for Astronomy and Astrophysics and Vigyan Prasar are jointly making a documentary film on AKR wherein he speaks out with his characteristic clarity and honesty. Fortunately, complete shooting of the film was done a couple of weeks before his death. We hope that the film would be able to reveal to the younger generation, his spirit of scholarship and dedication.

As a teacher, AKR set a benchmark for performance; he was a role model for students to emulate. AKR was a legend. A good measure of a teacher is reflected in the heights scaled by his students. Several of AKR’s students are now well-recognized scientists. As a researcher, AKR made an important contribution—the Raychaudhuri equation governing the dynamics of the universe, which will stand firm so long as Einstein’s theory of gravitation—general relativity (GR) stands. We must say here that after the monumental contributions of Jagdish Chandra Bose, C. V. Raman, S. N. Bose and Meghnad Saha, few Indian contributions have been as important.

AKR was born in Barisal, now in Bangladesh, on 14 September 1923. His father taught mathematics in a school in Kolkata. After his schooling, AKR joined the Presidency College, which was later to become a playground for his glorious academic innings. After MSc he joined the Indian Association for the Cultivation of Science (IACS) in 1945 as a research scholar and was asked to do experimental work which he was not cut out for. This lasted for four years of sheer frustration and agony. Undeterred, he taught himself in complete isolation the abstract and difficult differential geometry and GR. It is this drive of self-learning which formed the foundation for his later work. AKR taught for a couple of years at the Asutosh College. Once again he joined IACS in 1952 as a Research Officer, with clear instructions to work on the problems assigned by the Director and the Head of the section. This was indeed the most trying time of his research career. GR was not considered worthy of attention of a young researcher and he was asked to work on electronic energy bands in metals. He had to write two papers just to keep his job at IACS. The path-breaking equation was derived in 1954 under such adverse and challenging circumstances. Anyone else could have buckled down under such hostility and would have happily carried on studying metals and their properties, but not AKR. This unflinching strength, courage and commitment to work is what made AKR stand out.

When he joined the Presidency College as Professor in 1961, a glorious and most rewarding academic career unfolded for nearly three decades. AKR trained and inspired a galaxy of brilliant students, many of whom are at the frontiers in their fields of interest. Against the backdrop of all good scientists flocking to research institutions rather than universities, people like AKR who are few and far between served as lighthouses, inspiring and exciting young minds.

Before deriving his celebrated equation, AKR wrote one of the very first papers on condensations in the expanding universe and also discussed in another paper, the question of Schwarzchild singularity, which was at that time generally believed, including by Einstein himself, not to be attainable. AKR constructed a non-static collapsing solution and showed that there was nothing to prevent such a happening. The Schwarzchild radius is non-singular, but there is a genuine physical singularity as the radius goes to zero, where spacetime curvature diverges. In cosmology too, there is the big-bang singularity of the homogeneous isotropic and expanding universe. The natural question to ask was whether singularity of gravitational collapse or of the expanding universe is due to homogeneity and isotropy or generic and inherent character of GR, Einstein’s theory of gravitation? For instance, could rotation which opposes gravity avert its occurrence? AKR then addressed the fundamental question of singularity in the most general form with no reference to any symmetry and any specific property of spacetime and energy distribution. He considered evolution of a congruence of ordinary particles, which are characterized by time-like velocity vector, under its own gravity. Taking the time-like velocity as the eigenvector of the Ricci curvature and using the Einstein equation, AKR obtained the celebrated equation. The most profound result emanating from the equation was that singularity is a generic and inevitable feature of GR. It was left to the mathematical prowess of Roger Penrose and Stephen Hawking to prove, in the mid sixties, the most general and powerful theorems to establish this result rigorously.

It was only in the late fifties when he learnt that his paper was much talked about in the West and was referred to by Jordan and Heckmann that AKR gained confidence to submit his thesis for DSc in 1959; it was greatly appreciated by the legendary John Wheeler. First recognition came from far, and yet it did not make much news at home until Jayant Narlikar’s return to India in 1972. It is only then that AKR surfaced on the Indian scene and slowly academics and other academic agencies started taking note of him.

It is noteworthy that though AKR was an icon, not many of his good students took to research in GR. This was perhaps because he thought that there was greater excitement and action in other fields like high energy and condensed matter physics. To his students, he was only three questions away. When one returned from a visit to Kolkata, the enquiry would proceed in this order; how did you find Kolkata, did you go to the Coffee House and how was AKR?

Had he the benefit of a good mathematico-physical group equipped with the sophisticated techniques of differential geometry and global analysis, it was quite possible that
Usha Ranjan Ghatak (1931–2005)

Usha Ranjan Ghatak was born at Brahmanberia, now in Bangladesh on 26 February 1931 as the fourth of six sons and one daughter to Hem Ranjan Ghatak and Soudamini Devi. He got his early education in the then East Bengal and passed the Matriculation examination in 1947. After partition, Ghatak moved to Agartala, Tripura where he passed his I Sc Examination in 1949. He then migrated to Calcutta and obtained his B Sc degree with honours in chemistry from Asutosh College. He received his Master’s degree in chemistry from Calcutta University as a topper in 1953 and secured the Calcutta University Gold Medal and Motilal Mullick Medal. Ghatak then joined the group of P. C. Dutta, a renowned synthetic organic chemist at Indian Association for the Cultivation of Science (IACS) and obtained his Ph D degree in 1957 from Calcutta University. After spending another two years in IACS as a research associate, Ghatak moved to USA for his postdoctoral assignments in 1959. During the following four years he worked at the University of Maine (Orono, Maine), the University of California, Berkeley and at St. John’s University, New York in the wide field of organic chemistry from natural products to peptide synthesis.

Ghatak returned to India in 1963 and joined as a reader in the Department of Organic Chemistry, IACS. He started his independent research in the area of organic synthesis. Within a short time Ghatak established himself as an organic chemist of high repute both nationally and internationally. He made substantial contributions to methods for stereochemically controlled organic synthesis, particularly in the fields of polycarbocyclic diterpenoids and bridged-ring compounds related to bioactive natural products. His work is marked by a deep understanding of the conformational, steric and mechanistic factors which control bond formations in organic synthesis.

In the early stages, Ghatak and his co-workers developed a simple stereocontrolled total synthesis of some resin acids of profound contemporary interest and settled the stereoreactive assignments of all the four possible racemates of deoxy-xopodarcarpic acid, deisopropyl dehydro-abiatic acid and the corresponding 5-epimers. These discoveries clarified the stereochemical uncertainties that existed in the literature for the related synthetic compounds and have been widely referred to by later workers in the field.

Ghatak developed a general synthetic strategy which has considerable potential towards synthesis of a larger number of tetracyclic gibbines and phyllocladone synthons based upon intramolecular copper-catalysed carbenoid addition to double bond by thermal decomposition of 1,8-unaturated diazomethyl ketones. This has been successfully demonstrated in achieving the total synthesis of compounds related to gibberellins, the plant hormones. These molecules posed a challenging synthetic problem from structural as well as stereochemical points.

During the last phase of his tenure in IACS, Ghatak secured a remarkable achievement in free radical cyclization chemistry. The regio- and stereo-specific 6-endo and 7-endo-aryl radical cyclization leading to a simple convergent general method of synthesis for some linear polycarbocyclic systems was developed. This protocol was successfully employed in stereocontrolled generation of several chiral centers in a single step.


As Head of the Department of Organic Chemistry (1977–89), Ghatak steered the department in the right direction and brought glory to it through his own research contributions as well as providing guidance to other faculty members. During his tenure, several sophisticated instruments like high field NMR, GC and LC were procured for the department. Ghatak shouldered responsibilities of the Institute as Director in 1989 at a crucial time and made significant improvements during his four-year term. During his superannuation he continued as Professor of organic chemistry till his retirement in 1996 from IACS. Ghatak then joined Indian Institute of Chemical Biology, Kolkata as Emeritus Scientist and was associated with this institute till the end. He served as member of INSA Council, IASC Council, Editorial Boards of Indian Journal of Chemistry, Section B and Proceedings of the Indian Academy of Sciences, DST and CSIR PAC and many other scientific bodies.

Ghatak was loved and admired by all in the academic community. He was always approachable and extended a helping hand to everyone. Ghatak passed away on 18 June 2005 at his residence after a massive heart attack leaving his wife, Anindita, relatives and numerous students, associates and friends in grief. With his passing away, the country has lost a great synthetic organic chemist.

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