

Soldiers of Science: A Profile

PROFESSOR D. P. BURMA [1925-2005]: REMEMBRANCE AND RECOLLECTIONS OF A HERO OF INDIAN SCIENCE

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Abstract: Prof D.P. Burma, a distinguished researcher in the field of ribosome structure and function, played prominent role in establishing the roots of biochemistry/molecular biology during early 1960s, in India with Banaras Hindu University as its centre. He was pioneering in establishing separate departments of biochemistry in medical institutes/colleges and trained a generation of scientists in his classroom and laboratory.

Keywords: D. P. Burma; Debi Prosad Burma; ribosome; molecular biology in India; teacher of biochemistry; molecular biology unit BHU

“If I have seen further, it is by standing on the shoulders of giants”. These words of Sir Isaac Newton have eternal relevance in history of science and more suited to the Indian context. One such personality was Prof. D.P. Burma. Prof Debi Prosad Burma was pioneer of modern biological science era in post independent India. He was one of the famous ‘Troika’ of three B’s (D.P. Burma, B.K. Bhachawat and P.M. Bhargava) who made decisive contributions in firm establishment of molecular biology in India during mid twentieth century (Figure 1).

Quite early in his scientific career, during his doctoral work at Calcutta University (Ph.D, 1954), he published two papers, one in *Nature* and other in *Science* with a span of two years as single author related to chromatographic separation of amino acids and purines (Burma, 1951; Burma, 1953). It was under the influence of Dr. D.M. Bose, he moved to biological sciences.

He joined Prof Burris’s laboratory in 1955 at University of Wisconsin, Madison in U.S.A and demonstrated protein synthesis with cell free extract of *A. vinelandii* (Burma and Burris, 1957a, 1957b). This was perhaps the first report with a microbial cell free extract. Around this time, ribosomes were just recognized as sites of protein synthesis but nothing much was known about them. He shifted then to Prof B.L. Horecker’s lab, at NIH, Bethesda, and in a year published two papers in *Journal of Biological Chemistry* in year 1958. A physical chemist was turned into an enzymologist. His creative mind and aptitude to venture into frontier areas of research in modern biological science landed him in Prof Ochoa’s laboratory where he worked on DNA dependent synthesis of RNA. Prof Ochoa was later awarded Nobel Prize for isolating polynucleotide phosphorylase from *A. vinelandii*.

Dr. K.N. Udupa, Founder Director of Institute of Medical Sciences (I.M.S) at Banaras Hindu University (B.H.U.), invited Dr. D.P. Burma to join as Professor and Head, Department of Biochemistry and Biophysics, at I.M.S. in 1964. With insistence from Prof P.S. Sarma, eventually he accepted the offer and joined in October 1964

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on the day of *Mahalaya*. Starting from scratch, without any infrastructure and facilities as well as instrumentation, painstakingly Dr. Burma established a well equipped department which found space in the new building of the institute. At that time, Biochemistry was being taught in medical colleges much before the teaching of Biochemistry started in faculty of science. In one of the seminal contribution to teaching of Biochemistry to medical undergraduates and postgraduates, he revised the curriculum, both in theory and practice involving synergy of basic science with clinical relevance. It led to excitement among medical students towards Biochemistry. The Department of Biochemistry of I.M.S, served as beacon light to many other medical colleges across the country. Dr. Burma was instrumental in efforts which eventually led Medical Council of India to hold separate examination in Biochemistry in medical colleges and institutes.

In another major initiative, Prof Burma took the challenge to initiate teaching of Biochemistry in science faculty at B.H.U., which at that time has no department of biochemistry. His efforts wore fruits and thus master's course in Biochemistry was started as interdisciplinary effort in 1966 with faculty resource from science and medical faculties. The new sapling was transferred to Department of Chemistry and eventually in 1984, B.H.U. got its independent Department of Biochemistry in faculty of science.

Along with these activities, in mid 1970s, at Banaras Hindu University, Varanasi, Prof Burma's research group was keenly involved in pursuit of the enzyme responsible for turnover of messenger RNA. Dr. Kalpana Chakraborty, who was then Ph.D student, partially purified RNaseI from the extract of *S. typhimurium*. Dr Alok Datta pursued this further and in an effort to purify the enzyme to homogeneity, observed that an inhibitory substance in the extract interfered with the RNase I activity. The inhibitory substance turned out to be ribosome. This led him in the active area of understanding ribosome structure and function, to which he remained deeply fascinated and involved throughout his rest of the scientific career.

He undertook extensive studies of *E. coli* ribosome and its subunits and provided significant insights into structural organization of 30S and 50S subunits. One of the important contribution the group provided was demonstration that 30s subunit was less flexible than 50S and demonstrated a RNA rich protein poor region, located close to the base of 17/L12 stalk of 50S. He became more and more interested in the role of ribosomal RNA and conformational changes of ribosomal RNA and envisioned functional role of rRNA in ribosomes. This was a provocative hypothesis in times when ribosomal RNA was merely supposed to act as scaffold for ribosomal proteins. The catalytic prowess was attributed to proteins. In the field of ribosome research scientific groups were frantically searching for elusive peptidyl transferase, which they firmly believed was a protein enzyme. Catalytic RNA was not discovered either and talk of RNA as catalytic molecule was thought to be against existing knowledge and wisdom.

In early 1980's, his group made remarkable and path breaking discovery in a set of experiments where they demonstrated 16S rRNA and 23S rRNA could form a binary complex *in vitro* which was capable of weak ribosome like activity as several steps of protein synthesis were demonstrated with the addition of limited number of ribosomal proteins and factors required (Burma, et al, 1983; Burma et al, 1985a). These studies were first of their kind and well ahead of time in terms of philosophical breakthrough.

There after he turned specifically to elongation phase of protein synthesis and proposed a model of translocation based on interconversion of two types of ribosomal populations in *E. coli* (Burma et al, 1985b).

Promoting scientific research was another passion of Prof. Burma. Soon after establishing Department of Biochemistry in I.M.S, B.H.U., he established Molecular Biology Unit (MBU) in I.M.S, so as to exclusively promote scientific research in the area of molecular biology. A small and compact laboratory, it hosted state of art instruments along with conceptual design which still can serve as a template for founding small compact labs. The entire lab had main building

which comprised of three floors. Each floor has main research lab with working benches, writing desks for research scholars, cold room and office cabin spaces for faculties. This was supplemented by separate instruments rooms on the floor with ancillary support facilities. The laboratory was equipped with its own standby power supply in case of electricity failure and hosted an in house liquid nitrogen plant, animal house, tissue culture facility and well equipped library. All this happened as early in 1980's.

As early as in 1966, Prof Burma organized a national symposium on molecular biology entitled "Molecular Biology Sessions" at I.M.S., B.H.U. Again in 1976, an international symposium on "Molecular Basis of Host - Virus Interaction" was organized at B.H.U. where Max Delbruck delivered the inaugural address. February 7 of each year, which was the foundation day of Molecular Biology Unit, I.M.S; B.H.U. was celebrated yearly by Prof Burma by organizing a symposium where pioneers in the area of biochemistry, molecular biology and biophysics delivered talks to eager and curious gathering of teachers and students in B.H.U. He was one of the instrumental members who helped the launch of journal, now known as Indian Journal of Biochemistry and Biophysics, in 1961 in association with CSIR.

Prof Burma was also an exceptional mentor (Figure 2). He had a gift for formulating important hypothesis. He instilled a pragmatic attitude towards experimental design as well as warned of the dangers of distractions while interpreting results. Often he would remind his students about the thin line between hypothesis and speculation. One of his frequent retort to his students was "Experiments never lie". He set example by his own disciplined life. He would often emphasize that students receive their lessons from a living teacher not from textbooks alone. Every morning he was in the lab at sharp nine and his first assignment was discussion with Ph.D students along with their detailed lab records. He made it a point that whatever work was done during a day, must be detailed in a systematic manner in lab book before the student leaves the lab for the day. He was for small innovations to sort out various technical problems which a researcher



Figure 1: Prof D.P. at a scientific conference.



Figure 2: Prof. D.P. Burma (centre) in National Institute of Immunology, New Delhi with his students and two sons, Dr. Pradip Burma (extreme left) and Dr Sandeep Burma (extreme right), who are able scientists in their own right,

faces. He also made his students familiar with routine maintenance and minor repair of the instruments which they used. Students who graduated from his lab rose to great heights in their professional career and decorated important positions throughout the country as well as abroad. He was quite actively associated with Indian Biophysical Society, Society of Biological Chemists, India and Guha Research Conference, India.

A savant scientific intellect and a luminary figure, Prof. D.P. Burma, was source of

inspiration, guidance, to a large number of students. He lived a simple modest life away from glitter and glamour. With a fiercely creative mind seasoned with rigor, he charted his own course in the field of ribosome research and made seminal contributions. He belongs to the rare class of scientists who were free to pursue whatever questions they wanted, with the possibility that they may make huge strides in discovery.

A great champion of hypothesis driven science he firmly believed in words of Karl Popper *"The game of science is, in principle without end. He, who decides one day that scientific statements do not call for any further test, and that they can be regarded as finally verified, retire from the game"*. His passion and quest for science find poetic expression in the words John Keats:

*"Heard melodies are sweet, but those unheard
Are sweeter; therefore, ye soft pipes, play on;
Not to the sensual ear, but more, endear'd,
Pipe to the spirit ditties of no tone"*

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References

- Burma, D.P. (1953). Separation of the purines and pyrimidines by ionophoresis on filter paper. *Science* 118, 694-695.
- Burma, D.P. (1951). Effect of temperature on the Rf values of the amino-acids during paper chromatography with solvents completely miscible with water. *Nature* 168, 565-566.
- Burma, D.P. and Burris, R.H. (1957a). Kinetics of ammonia utilization by *Azotobacter vinelandii*. *J. Biol. Chem.* 225, 287-295.
- Burma, D.P. and Burris, R.H. (1957b). Metabolism of nitrogen by cell-free preparations from *Azotobacter vinelandii*. *J. Biol. Chem.* 225, 723-733.
- Burma, D.P., Nag, B., and Tewari, D.S. (1983). Association of 16S and 23S ribosomal RNAs to form a bimolecular complex. *Proc. Natl. Acad. Sci. U S A.* 80, 4875-4878.
- Burma, D.P., Tewari, D.S. and Srivastava, A.K. (1985a). Ribosomal activity of the 16S.23S RNA complex.. *Arch. Biochem. Biophys.* 239, 427-435.
- Burma, D.P., Srivastava, A.K., Srivastava, S. and Dash, D. (1985b). Interconversion of tight and loose couple 50 S ribosomes and translocation in protein synthesis. *J. Biol. Chem.* 260, 10517-10525.