

A century of biochemistry at IISc

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The Department of Biochemistry at the Indian Institute of Science (IISc), Bengaluru (Figure 1), will commemorate its 100th birthday with a series of themed activities throughout 2020–21. The 100th anniversary celebrations of the department was formally inaugurated by C. N. R. Rao with a one-day Symposium and an exhibition showcasing its distinguished history, major scientific contributions and other milestones on 21 February 2020. The Centenary International Conference and Global Alumni meet is scheduled for 10–12 December 2020, with talks and presentations by alumni, researchers, industry experts and entrepreneurs.

A brief account of major scientific discoveries and contributions of the department has appeared in the guest editorial column of *Current Science*¹. Therefore, the purpose of this commentary, to some extent, is not intended to illustrate numerous academic developments, but to look at the centennial year through the prism of historic figures who shaped the Department and its evolution towards academic excellence. The Department of

Biochemistry has one of the most unique and interesting histories at IISc. The Department was founded by a Paris-born Biochemist, Gilbert J. Fowler. He lived most of his life in Bangalore and died here on 21 March 1953. He was appointed as Chairman of Applied Chemistry at IISc in March 1916. In 1921, he was named the Founding Professor and Chairman of the newly created Department of Biochemistry, oldest in the Indian subcontinent. Since the very inception of its illustrious academic journey, the Department has been a home for fifty-five teaching faculty members (as of 2019). The research in the Department first focused on sludge-based fertilizers as a means toward improving agriculture as well as nutrition, and separation and identification of biomolecules using analytical methods. Since its inception, the vitality and growth of the Department has played a pivotal role in training generations of men and women scientists who have gone onto leadership positions in the country and beyond. The Department has graduated nearly 1000 students at the Ph D level. Our students have pur-

sued successful, interesting careers in the biochemical and medical sciences in academia and industry, entrepreneurship, as well as government and nongovernment funding agencies in India and abroad. In addition, the Department has provided opportunities for research training at various levels – to summer trainees, postgraduate students, research assistants and postdoctoral researchers. Periodically, the Department through workshops has provided young and mid-career researchers with state-of-the-art facilities and extensive opportunities to gain practical hands-on experience in advanced molecular techniques.

In a remarkable milestone in every respect, Kamala Sohonie, battling gender-based prejudice, was the first female student to gain admission to IISc and also the first woman to receive an M Sc degree from this Department in 1936. Legend has it that she was told that women could not attend IISc to pursue higher education! As a fitting tribute to this inspirational lady, the Ministry of Women and Child Development, GoI, recently has proposed to establish a national chair professorship in her honour. By 1931, the Department had its first Indian-born Head, V. Subrahmanyam, who later became the founding Director of CFTRI at Mysore. A brilliant cytogeneticist, M. K. Subramaniam, provided the first evidence for the existence of nuclear envelope, the presence of chromosomes, types of ploidy and their segregation pattern during cell division in brewing yeast. Many of the Department's early contributions had roots in both agriculture and a fundamental understanding of biology – for example, human nutrition, metabolism and plant diseases to technology, and in the large scale production of medically important entities such as insulin.

During the second quarter-century, the Department became well-established and rose to international prominence as a vibrant teaching and research entity. The basic research was an important component of the Department early on with focus on a broad range of natural biomolecules and cells, and also catering to the needs for trained manpower development



Figure 1. The Department's first building, circa 1920s (upper), 2010 (lower).

with strong skills in the field of life sciences. K. V. Giri during his tenure as the head laid the foundation for studies on proteins and enzymes. P. S. Sarma took the department's helm in 1959. He is widely credited with devising a roadmap for the department's extraordinary growth in the decades of 1960s and into the early 1970s. His tenure was marked by important changes in a variety of ways, all meant to enhance the academic robustness and impactful research. During his reign, research in the disciplines of molecular biology and endocrinology, classroom teaching and weekly seminar series were initiated.

In the decade of 1960s, under the tutelage of a visionary and progressive-minded Director, Satish Dhawan, the Biochemistry Department boomed: its strength, its scope, enhanced and resources expanded. A vast shake-up occurred in the recruitment of faculty: 18 full-time faculty members were recruited with strong research interests in all of the traditional areas of biochemistry. This period also ushered in a paradigm shift in the research interests of the faculty: from microbiology and nutrition to enzyme biochemistry, enzymes involved in the degradation of aromatic compounds, myelination and lipids in brain function, plant development, bioenergetics, regulation of cholesterol biogenesis, and strengthened research on the mechanism of action of vitamin A and its derivatives. There was an emphasis on modernization across the fields of enzymology, reproductive biology, lipid synthesis in the model eukaryotes and plant sciences. The addition of faculty (T. M. Jacob, J. D. Cherayil and J. D. Padayatty) with research focus on the structure and function of DNA and RNA in bacteriophages, bacteria and rice led to innovative research because it was not until the mid-1960s that molecular biology and molecular biology techniques were at the forefront of cutting edge biological research. As a result, the depth, the quality of research improved and cross-disciplinary collaboration between researchers from different disciplines had become more frequent. Most of today's generation largely takes it for granted or may not appreciate the ground-breaking efforts of G. Padmanaban in cloning specific genes which paved the way to the widespread adoption of genetic engineering tools across the Departments in IISc. The history of the Department would be

amiss without recognizing the tremendous work of N. R. Moudgal in the field of reproductive biology and endocrinology and his efforts in creating central facilities to house small animals and nonhuman primates at IISc. Overall, their collective influence remains profound.

In the 1970s, the Department's diversified research interests included a pivotal shift toward research at the molecular level, with focus on structure–function relationships of gonadotropins and their receptors, vitamin carrier proteins and their role in embryonic development, the modulation of inducible-gene expression and protein stability by heme and carcinogens, nucleic acids structure and function, enzyme kinetics and reaction mechanisms, biology of plants and fungi, pollen and shrimp allergens, and redox homeostasis in response to environmental and metabolic challenges. An open-minded Director in 1980s, C. N. R. Rao, with a wide-ranging academic vision unpadlocked the doors to direct recruitment of postdoctoral fellows to faculty in the Department and provided generous start-up grants, an unknown concept until then at IISc. To generations of traditional power groups, any kind of organizational change at IISc has been very intimidating. It is an unwelcome distraction for them. Over time, one learns to recognize the phobia, look behind the rhetoric and the antecedents of the visible. Soon it became apparent that you do not need to have the patronage of the power groups to do some meaningful work and achieve career goals. However, the experience remains etched in memory for a lifetime.

The decade of 1990s were academic growth years for cutting-edge research in the Department in focus areas, such as eukaryotic gene expression, chromatin structure and function, DNA recombination, structure and function of telomeres, enzymes and proteins, nucleic acid enzymology, as well as synthesis and degradation of lipids, signal transduction and secondary metabolites in plants. These areas of research have grown steadily since then. Indeed, we pioneered research in some of these emerging and interdisciplinary fields in India. Because of the diverse specialties, the number of students, postdoctoral fellows and research publications in front-rank journals has increased substantially over the last 30 years. Owing to the foresight initiative of C. N. R. Rao, a new Integrated Ph D programme in the division Biologi-

cal Sciences began in 1992, which has been emulated elsewhere in India. This author designed the course syllabus and served as its founding coordinator. The Department has responded appropriately by adding new courses in cell biology, molecular genetics, molecular biology and immunology. Since 2000, research funding received from national and international funding agencies has been at an impressively high level, both in terms of the number of awards and the amount involved, though in some cases this is shared with other collaborative groups.

The Department itself struggled with crumbling physical facilities and unequal space distribution. During P. Balaram's tenure as Director, and this author as the building committee chairman, a plan went into effect to integrate all the departments and core equipment scattered over several locations in the Division of Biological Sciences into one location. This effort yielded four different departments and core facilities being housed in a new four-storey building, which we and others occupied in 2012. In recent years, the Department has done a splendid amalgamation of distinct biological disciplines: biochemistry, molecular genetics, cell biology and immunology. At present, the department, building on our strong foundation, emphasizes outstanding research in areas such as transcriptional and translational control processes in yeasts and human cells, mechanisms underlying the maintenance of DNA stability and integrity in normal and disease states, yeast chromosome biology, molecular chaperones and post-transcriptional regulation in disease-causing protozoa, mitochondrial protein biogenesis and translocation, T cell activation and immunological recognition in host–pathogen interactions and computational systems biology. Our faculty has taken up research problems of vital interest to India. Historically, the Department helped in producing medicines for wounded soldiers in World War II. The production of indigenous hepatitis B vaccine and its inclusion in the immunization programme of the country, and the Drugs Controller General of India's approval of curcumin combination therapy for phase II clinical trial against malaria is noteworthy. Other findings from the department on disease-causing protozoan parasites have potential translational relevance. The synergetic collaborations with colleagues, including structural

biologists, medicinal chemists, physicists and engineers within IISc and outside have been very fruitful. One of the Department's legacies is the quality and rigour of our academic programme with appropriate modifications to it over the course of its history. Over its century of existence it has made a broad and invaluable contribution to the growth of biochemistry and human resource development in India as well. In 2001, the author of this article founded the first structured DBT national postdoctoral training programme in biotechnology and life sciences and a similar dedicated programme for the Northeast region. The faculty of the Department have contributed very significantly being chair/member of the expert committees of numerous Government S&T Departments (including BIRAC) and served to launch new institutions such as CFTRI (Mysore), Lac Research Institute (Ranchi) and the Astra Research Center (Bengaluru).

In summary, Gilbert J. Fowler would not be surprised by the growth, breadth

and depth of research being pursued in the Department. The trailblazer, Kamala Sohoni would be pleased with the growing gender equality in the Department (and in the Division of Biological Sciences). Very often, female students have outnumbered and outperformed their male counterparts in the Department. At the same time, what do the next 100 years and beyond hold for the Department? While much has changed during the last 10 decades, biochemistry has been and will continue to be relevant as the fundamental discipline because upon which so many other disciplines depend. The 100-year-old history informs us that the combination of cutting-edge research, teaching and outreach activities is why our Department has long been considered the go-to place for research and training in broad areas of biological sciences in India. As we mark the end of our centennial year, it is intensely encouraging that the Department is globally recognized for innovative research and high quality training of students in basic and applied

research. The biggest asset of our Department, I believe, is our students and postdoctoral fellows, supported by technical and administrative staff at various levels. Looking ahead, the root, however, may still reside more with the individual faculty members to contribute to its overall growth and achieve their respective career goals. I am confident that Department in the next century, building on its past strengths, will continue to set benchmarks for research and training in the field of Biological Sciences. I believe that the future is bright to our Department as it forges ahead into its next 100 years.

1. Rangarajan, P. N., *Curr. Sci.*, 2020, **118**, 331–332.

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