BIOSCIENCE IN INDIA

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Biosciences in India is at a threshold of a huge expansion: this is what we have been hearing for a long time. While it is clear that the growing economy and a laudable focus on basic sciences by the government has ensured a surfeit of jobs and opportunities for research (some information regarding these opportunities are provided below), it is also a reality that there is a real lack of qualified people applying for these jobs. For a country the size of India and with a science-oriented education system, this is indeed surprising.

Modern biological sciences in India has a long history: contemporaries of the Nobel laureate in Physics, CV Raman, circa 1930 (the physicist who discovered the 'Raman Effect': and was fascinated by the properties of Light and its interaction with matter- in particular with living matter), include JC Bose, a polymath whose comparisons between the physical properties of muscle and plants lead to a new discoveries in plant sciences, such as theories for the ascent of sap, as well as a connection between the excitability of plant and animal tissue [1]. And it is not a coincidence that the sense of self-confidence that physicists in India have enjoyed, allowed them to make huge contributions to the development of biological sciences in India. GN Ramachandran, a physicist, after whom is named the Ramachandran plot, a graphical way to categorize the dihedral angles ψ against φ of amino acid residues in protein structure, that shows the possible conformations of ψ and φ angles for a polypeptide backbone in existing proteins, was a pioneer in every sense. His study of protein structure by X-ray crystallography in the early 1950's in newly Independent India at Madras University was a remarkable effort. He also began the Molecular Biophysics Unit at the Indian Institute of Science at Bangalore in 1970. He is considered one of the founding pillars of Structural Biology in India and has spawned a vibrant tradition of Protein science in India. It is then no coincidence that with an emphasis on the study of mathematics and computer science, the growth of Bioinformatics in protein structure prediction and analysis is a natural outcome; much of research and education in the Biological sciences in India emphasizes this aspect of Structural Biology.

In the first three decades after independence in 1947, Biochemistry grew seeded by pioneers at the Indian Institute of Science, the Christian Medical College in Vellore and in laboratories in Kolkota. Delhi University was an important centre for plant embryology. Bacterial and yeast genetics and *Drosophila* neurobiology grew at the Tata Institute in Mumbai. These centres spread their intellectual progeny to other locations all over the world. Yet, within India there are only a few pockets of excellence. Biophysical and biochemical approaches dominate the research landscape, reflecting the early and wide start of these approaches to address questions in biology [2]. Although this was the case until recently, Biological Sciences in India is going through a renaissance of sorts [3]. The situation is changing rapidly; in the past five years, the opportunities for research in Biological Sciences have grown tremendously.

From 2007 to 2012 (the end of the current 5 year plan), India has seen a fourfold increase in science and technology funding. This has raised research support from 0.8% to 1.3% of GDP. Support for basic research has increased threefold in this period. The current five-year support cycle ends in 2012 March has seen a support for life sciences of about US$ 2 billion. The next five year cycle can expect a doubling of this.

Major funds have been announced for infrastructure development by the Departments of Science and Technology and the Department of Biotechnology. A new Department of Health Research has been created by the government, intended to boost biomedical and clinical research. Life science research has seen a major share of these increases. Support for life science research has increased 16-fold in the past 20 years. The Indian Parliament has this year approved a new National Science and Engineering Research Board (NSERB), with a mandate similar to the US National Science foundation with an initial injection of about US $ 330 million for the first year. The NSERB's mandate is to primarily help in rejuvenating science in the University system. Understanding that research rests on a strong foundation in education, the government has increased support for education from 7.5 to 20% of GDP to increase the access to a decent education for a majority of its citizens, having just passed a Right to Education (signifying that education a fundamental right and its access is a Government responsibility).

A host of new institutions for research and education have also been created, including 30 new centrally funded universities, 8 new Indian Institutes of Technology, and 5 Indian Institute of Science Education and Research (ISER) modeled on the well-known Indian Institute of Science in Bangalore. The Department of Biotechnology has created major research clusters: For Agribiotech in Mohali near Chandigarh, for Translational Research and Biotech research training and education in the National Capital region and for Stem cell biology in Bangalore. The Department of Biotechnology of has been actively involved in stimulating the biotech industry. While still small the trend of growth indicates many opportunities related to research in the Life sciences, including a huge incentive to create start-ups as well as encourage entrepreneurship. The Council for Scientific and Industrial Research (CSIR) laboratories have also been given a huge fillip in terms of investment: its current yearly budget is about $300 million. While the ambit of this agency is to encourage research that has a more applied angle in all fields of science and engineering, in the biological sciences it is spearheading a huge focus on genomics and biomarker and drug discovery.

Given all these incentives and opportunities there is a tremendous surge in the number of jobs that have become available for the researcher who wishes to pursue a career in India. The government is gambling on bringing back young scientists to help grow Biosciences in India [4], unlike the strategy adopted by our neighbour, China, where huge incentives are being offered to attract established scientists at mid-level positions to relocate to its shores. A new independent portal, www.IndiaBiosciences.org [5] has been set up 'for Indian biologists (junior and senior, working in India or abroad) to unite as a community- to find and exchange information, to make new contacts and find collaborators, to share perspectives, to attract a new generation of young people to scientific careers, and to welcome back talented Indians who previously might have established their careers abroad'.

However, despite all these incentives, a major factor that is holding back Indian Bioscience is the lack of a trained and motivated research manpower. This too may be set to change. Internationally many researchers are helping in this endeavour. Meetings to attract and inform scientists interested in India are being held in almost every major centre of biomedical research. Many scientists of Indian and non-Indian origin have taken up the gauntlet of helping to attract researchers to India. This is already having a very major impact in India, and helping to recruit talent to Indian research institutes. There are now several major science fellowship programmes to attract starting as well as mid-level scientists to these opportunities. These include the Ramalingaswami (from the Department of Biotechnology) and Ramanujan fellowships (from the Department of Science and Technology) and those from the Wellcome Trust- DBT India Alliance. In addition special schemes from the Wellcome Trust-DBT are in place to promote a national postdoctoral culture, necessary for any major scientific endeavour to succeed today.

Here nationally or internationally trained PhDs will be able to spend up to two years, if they wish, a collaborators laboratory anywhere in the world, and the balance of the 4- year fellowship in the mentor's laboratory in India. This will allow senior Indian scientists to develop scientific programmes where they can rely on leadership from within their group and secondly, graduate students can augment their learning experiences from senior postdoctoral researchers. Many young scientists are also taking up careers in science management and establishing state of the art core facilities as alternative careers to becoming PI and running research laboratories, fuelled by the successes of some good role models.

Considering the Wellcome Trust DBT India alliance schemes as an example of how much difference these new incentives are making to attract top quality scientists to India may be an important lesson, and point to the challenges ahead. While many of the Alliance schemes have been put into place just to aid such transformations and are already making an impact in one year of its existence, the ability of the Alliance to find suitable candidates however, remains hugely undersubscribed at the moment. The Alliance has an annual budget of about 20 million USD which can fund up to 70 fellowships a year at all levels. In the first year only 24 fellowships across all the categories were awarded. Subsequently several changes to the eligibility conditions have been made and The Alliance expects to fund at least double the number of awards in the second and third years. In terms of building up trained manpower capacity at Indian institutions, the international affairs committee of the ASCB has also taken a lead in augmenting Teaching and Research initiatives in India (see ASCB August 2010 Newsletter) and are looking for members to take the plunge.

In addition to all the above, located around creating capacity in a typical mould of a Global bioscience research community, Bioscience research in India affords unique opportunities that are worth mentioning. With its tremendous biodiversity and varied biogeography, there is a wealth of new biology waiting to be discovered. The discovery of new species of amphibians, primates and insects is a frequent occurrence, and are not even newsworthy these days. Marine ecology and its attendant biology is also a hugely untapped area of study for the intrepid cell biologist. The scientific base behind the many vibrant traditional medicine practices (currently submerged in rhetoric and commercial hype) intertwined with a unique knowledge of the efficacy and potency of plant extracts to treat diseases, is also a rich resource.

While these traditional health practices have resulted in a personalised medical practice that rivals the prophecies of the futuristic ideas of genomic medicine, an understanding of its empirical basis from a physiological, cellular and molecular perspective remain largely unexplored. An important focus of any scientific understanding of these medical practices must involve a detailed understanding of the history and theoretical foundations of these practices. An acknowledgement of this rich heritage has resulted in the formation of a new department focused on the study of these traditional practices[6] providing a detailed compendium of a very elaborate pharmacopeia of Ayurvedic, Unani and Siddha practices. In addition many commercial entities are using a traditional practice-based bias to explore new drugs for contemporary diseases.

Given the many new opportunities, the future looks bright for the Biosciences in India, especially if there are people ready to take the plunge. A cultural transformation is taking place, in new institutions and old, which welcomes new researchers into an environment of collective effort towards broadening the base of quality science. It's a good time to dive in!

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